

10-3930-233-35

TM 10-3930-233-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT MAINTENANCE MANUAL

TRUCK, LIFT, FORK, GASOLINE
SOLID RUBBER TIRED WHEELS

2,000 LBS CAPACITY

ARMY MODEL MHE-182

ALLIS-CHALMERS MODEL FT20-24PS-100

FSN 3930-958-3682

ALLIS-CHALMERS MODEL FT20-24PS-127

FSN 3930-958-3683

HEADQUARTERS, DEPARTMENT OF THE ARMY
JANUARY 1964

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TECHNICAL MANUAL

No. 10-3930-233-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON D.C., 20 January 1964

Field and Depot Maintenance Manual

TRUCK, LIFT, FORK, GASOLINE, SOLID RUBBER TIRED WHEELS

2000 LBS CAPACITY, ARMY MODEL MHE-182

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CHAPTER 1 INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for use by personnel responsible for field maintenance (third and fourth echelon) and depot maintenance (fifth echelon) of the Truck, Lift, Fork, Gasoline, Solid Rubber Tired Wheels, 2000 Pound Capacity, Allis Chalmers Model FT20-24PS-100, Army Model MHE-182, 100 Inch Lift Height, Radio Suppressed, Federal stock number 3930-958-3682, 127 Inch Lift Height, Radio-Suppressed, Allis-Chalmers Model FT20-24PS-127 Federal stock number 3930-958-3683. Instructions in this manual are applicable to trucks procured under contract number DSA-4-1674.

b. The direct reporting by the individual user, of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended Changes to Technical Manual Parts Lists or Supply Manual 7, 8, or 9) will be used for reporting these improvements. This form will be completed in triplicate using pencil, pen, or typewriter. The original and one copy will be forwarded to the Commanding Officer, U. S.

Army Mobility Support Center, ATTN: SMOMS-MM, P. O. Box 119, Columbus, Ohio 43216. One information copy will be provided to the individual's immediate supervisor (e.g., officer, noncommissioned officer, supervisor, etc.).

2. Appendixes

Appendix I is a list of current references applicable to this manual. The maintenance allocation chart is published in TM 10-3930-233-20. Repair parts and special tool lists authorized for field and depot maintenance, are published in TM 10-3930-233-35P.

3. The maintenance forms, records, and reports required by field and depot (third, fourth and fifth echelon) mechanics are listed and described in TM 38-750.

4. Orientation

Throughout this manual the use of the terms right, left, front, and rear indicates directions from the viewpoint of the operator sitting in the seat of the truck.

Section II. DESCRIPTION AND DATA

5. Description

A general description of the truck is found in TM 10-3930-233-10. Any required addition-

al description of a specific component of the truck will be found in that section of the manual pertaining to the component.

6. Data

Engine Assembly:

Overall:

Make.....	Waukesha
Model.....	FCB-133
Type.....	Valve in block
Number of cylinders.....	4
Piston stroke.....	4 in.
Bore.....	3.250-3.2515 in.

Compression ratio.....	6.5:1
Piston displacement.....	133 cu. in.
Firing order.....	1-3-4-2
Governed speed.....	2200 rpm
Idle speed.....	600 rpm
S.A.E. rated horsepower:	
Maximum.....	33 H.P. @ 2400 rpm
Intermittent.....	29.7 H.P. @ 2400 rpm
Continuous.....	26.4 H.P. @ 2400 rpm

Components

Crankshaft:

Journals:

Main:

Diameter.....	2.125-2.124 in.
Total number.....	3
Maximum allowable or out of round.....	0.0005 in.
Torque wrench pull on bearing cup bolts.....	88-92 foot lbs.

Rod:

Diameter.....	1.75-1.7
Total number.....	4
Maximum allowable or out of round.....	0.0005 in.
Torque wrench pull on rod cap nuts.....	44-46 foot lbs.

Bearings:

Main.....	3
Type.....	Precision thin shell inserts.
Clearance.....	0.0005-0.0025 in.
Connecting rod.....	4
Type.....	Precision thin shell inserts.
Clearance.....	0.0005-0.003 in.
End play.....	0.0075-0.0120 in.

Pistons:

Type.....	Aluminum alloy
Diameter (standard).....	3.247-3.2485
Clearance.....	0.003 feeler gauge 0.5 in. wide. Feeler must pull out with 4-8 lbs. pull.

Rings:

Compression:

Gap.....	0.010-0.015 in.
Side clearance.....	0.002-0.0035 in.

Oil Ring:

Gap.....	0.010-0.018 in.
Side clearance.....	0.0015-0.003 in.

Piston pins:

Type.....	Full floating
Diameter (standard).....	0.8743-0.8746 in.
Fit in rod.....	0.0001-0.0005 in.
Fit in piston.....	0.0001-0.0003 in.

Connecting rods:

Type.....	Forged I section
Side clearance (total).....	0.0075-0.0125 in.
Permissible weight variation.....	0.25 oz.

Camshaft:

End play.....	0.002-0.006 in.
Journals:	
Rear (truck rear).....	2.123-2.124 in.
Center.....	1.873-1.874 in.
Front.....	1.498-1.499 in.
Bushings type.....	Precision
Bushings running clearance.....	0.0015-0.0035 in.

Valves:

Stem Diameter:

Intake.....0.310-0.311 in.

Exhaust.....0.309-0.310 in.

Stem clearance in guide:

Intake.....0.001-0.003 in.

Exhaust.....0.002-0.004 in.

Valve clearance (cold):

Intake.....0.007-0.009 in.

Exhaust.....0.011-0.013 in.

Seat angle:

Intake.....45°

Exhaust.....45°

Seat width..... $\frac{1}{32}$ - $\frac{3}{64}$ in.

Valve spring:

Free length.....2 $\frac{1}{16}$ in.

Compressed.....36 ± 3 lbs. at 1 $\frac{3}{32}$ in.

Valve Guides:

Intake ID.....0.312-0.313 in.

Exhaust ID.....0.312-0.313 in.

Drive axle:

Ring gear:

Type.....Bevel

Number of teeth.....36

Pinion gear.....Bevel

Number of teeth.....16

Ring gear to pinion backlash.....0.005-0.010 in.

Pinion bearings:

Type.....Taper roller

Number used.....2

Preload.....15-25 inch lbs.

Carrier bearings:

Type.....Taper roller

Preload.....15-25 inch lbs.

Steering gear:

Make.....Gemmer

Type.....Cam and lever

Hydraulic pump:

Make.....Cesna Aircraft Co.

Model.....X-15509-IFF

Type.....Gear

PSI.....2,000

GPM.....7.9

Hydraulic Control Valve.....16.4 gpm w/oil velocity of 22 fps

Distributor:

Make.....Delco-Remy

Model.....1111712

Voltage.....12

Rotation.....Clockwise viewed at rotor end.

Contact gap.....0.022 in.

Cam angle range.....31°-37°

Starter motor:

Make.....Delco-Remy

Model.....1107324

Type.....Bendix drive

Voltage.....12

No load test: -

Volts.....	11.6
Max., amperes.....	70.0
Min., RPM.....	6,000

Generator:

Make.....	Delco-Remy
Model.....	1102221
Type.....	Ventilated
Voltage.....	12
Rotation (drive-end).....	Clockwise
Ground Polarity.....	Negative
Brush spring tension.....	35 ounces

Output at 1,560 rpm:

Volts.....	15 cold
Maximum amperes.....	20

Voltage regulator:

Make.....	Delco-Remy
Model.....	1119304
Type.....	3-unit
Voltage.....	12
Ground polarity.....	Positive

Cutout relay:

Air gap.....	0.020 in.
Point opening.....	0.020 in.
Closing voltage.....	11.8-13.5

Voltage regulator unit:

Armature air gap.....	0.075 in.
-----------------------	-----------

Voltage setting:

65°.....	0.9 (subtract)
85°.....	0.6 (subtract)
105°.....	0.3 (subtract)
125°.....	0
145°.....	0.3 (add)
165°.....	0.6 (add)

Current regulator unit:

Armature air gap.....	0.075 in.
Current setting (amperes).....	18.5-21.5 amp

CHAPTER 2

MAINTENANCE INSTRUCTIONS

Section I. TROUBLESHOOTING

7. General

This section contains information that will help in both the diagnosis and the correction of common troubles.

8. Troubleshooting Chart

In the troubleshooting chart below, each symptom of trouble is followed by a list of probable causes and a suggested procedure for locating and remedying the trouble.

Troubleshooting Chart

<i>Trouble</i>	<i>Probable cause</i>	<i>Remedy</i>
Engine Misses	Warped valves	Replace (par. 14).
	Stuck valve	Clean stem and guide. Grind valve if necessary.
Engine Knocks	Loose connecting rod bearings (sharp knock, low oil pressure).	Replace bearings (par. 12).
	Loose main bearings (heavy knock-low oil pressure).	Replace main bearings (par. 11).
	Loose piston pins (sharp double knock)	Replace pins, or bushings (par. 12).
	Piston and cylinder wear	Replace pistons and rings (par. 12).
Loss of Power	Sticking oil relief valve	Remove oil relief valve, clean and repair (par. 20). Do not stretch spring.
	Leaky valves	Adjust or grind valve as necessary (par. 14).
	Worn piston rings	Replace rings (par. 12).
Explosion in Exhaust	Partially open exhaust valve	Clean, adjust, or replace broken or defective spring (par. 14).
Engine Runs Irregularly	Warped exhaust valve	Replace valve (par. 14).
	Leaky valves	Adjust, grind, or replace as necessary.
Transmission Does Not Shift, or, Truck Will Not Move.	Transmission control valve linkage out of adjustment.	Adjust control valve linkage.
	Transmission control valve dirty or defective.	Clean, repair or replace dirty or defective valve.
	Dirty transmission fluid	Check transmission fluid and replace with fluid specified in Lubrication Order.
	Transmission fluid low	Fill with fluid specified in Lubrication Order.
	Faulty transmission pressure pump	Check pump pressure and repair.
	Incorrect forward and reverse clutch pressures.	Check transmission clutch pressures and repair.
	Incorrect converter pressure	Check converter pressure and repair.
Smokey Exhaust	Worn pistons, out-of-round and tapered cylinders (blue smoke).	Replace rings (par. 12).
Ammeter Does Not Register (Generator not Charging).	Dirty commutator	Clean commutator (par. 26).
	Worn brushes	Replace (par. 26).
	Shorted armature	Repair, or replace (par. 26).
	Shorted field	Repair (par. 26).

Troubleshooting Chart (Continued)

Trouble	Probable cause	Remedy
Cranking Motor Failure	Commutator dirty	Clean commutator (par. 27).
	Worn brushes	Replace (par. 27).
	Bad teeth on flywheel	Replace ring gear (par. 17).
Failure to Move	Broken jackshaft	Replace (par. 38).
	Teeth broken on jackshaft or bull gear	Replace (par. 38).
	Broken teeth on differential ring gear or pinion.	Replace both ring gear and pinion; they are a matched set (par. 40).
Axle Noise on Drive or Coast	Excessive wear on ring gear or pinion	Adjust if possible, or replace (par. 40).
	Worn pinion gears or side gears in differential case.	Replace worn gears (par. 40).
Continuous Axle Noise	Excessive wear in gear train	Replace worn parts (par. 38, 40).
Excessive Backlash in Drive Unit.	Worn splines on jackshaft	Replace jackshafts (par. 35).
	Worn pinion, ring gear or differential case pinions.	Replace (par. 40).
	Loose or worn universal joints	Tighten or replace (par. 35).
Brake Pedal Goes to Toe Board	External leak in system or leak past master cylinder piston cup.	Check system and master cylinder for leak, and repair (par. 41).
Both Brakes Drag	Mineral oil in brake system	Clean out system, replace cups in cylinders (par. 41) and refill with approved brake fluid (TM 10-3930-233-20).
	Breather port in master cylinder clogged.	Clean out breather port (par. 41).
One Wheel Drags	Obstructed brake line	Remove obstruction or replace line.
	Swollen wheel cylinder piston cups, or piston binding.	Replace defective or damaged parts (par. 41).
Truck pulls to One Side	Lining charred or drum scored	Replace lining. Repair or replace drum (TM 10-3930-233-20).
Loss of Coolant	Cracked engine block or head	Replace damaged part (par. 10).
	Leaking radiator	Repair or replace (par. 25).
Ammeter Does Not Show Charge.	Worn generator brushes	Replace brushes (par. 26).
	Shorted generator armature	Repair or replace armature (par. 26).
	Shorted generator fields	Repair field coils (par. 26).
Ammeter Shows Discharge, with Engine Running.	Inoperative generator	Repair or replace generator (TM 10-3930-233-20).
Ammeter Fluctuates Rapidly	Dirty, loose or worn generator brushes	Clean and tighten brushes. Replace if necessary (par. 26).
	Defective generator	Repair or replace.
Cranking Motor Failure	Commutator dirty	Clean (par. 27).
	Worn brushes	Replace (par. 27).
	Broken drive unit	Replace (par. 27).
	Broken teeth on flywheel ring gear	Replace ring gear (par. 17).
Loose steering	Bent linkage	Replace damaged parts (par. 42).
	Binding steering gear	Repair or adjust (par. 42).
	Loose linkage	Tighten linkage or replace (par. 42).
	Loose knuckle pins	Repair or recondition (par. 36).
	Steering gear out of adjustment	Adjust cam and worn shaft (par. 42).
	Loose steering arm	Tighten (par. 42).
Low Hydraulic Oil Pressure	Worn pump	Recondition or replace (par. 47).
	External leakage	Tighten or replace fittings, hoses or seals (par. 47 thru 52).
Unable to Lift or Tilt Load	Load too heavy	Check capacity on Serial No. Plate (TM 10-3930-233-10).
	Damaged or worn pump	Remove and repair (par. 47).
	Broken lift chain	Repair (TM 10-3930-233-20).

Troubleshooting Chart (Continued)

Trouble	Probable cause	Remedy
	Damaged lift cylinder	Check for binding or any cause to make plunger inoperative (par. 52).
	Control valve inoperative	Inspect for internal leakage or damaged parts and repairs (par. 48).
Lift and Tilt too Slow	Internal leakage at pump	Inspect for worn or damaged parts (par. 47).
	Excessive leakage at cylinder packing ..	Repair or replace packing (par. 51, 52).
	Air leaks in system	Tighten all connections.
	Misalignment	Check masts, carriage or tilt linkage for cause of binding (par. 50, 53, 54).
Load Creeps—Tilting or Lowering.	Internal leakage in cylinders	Repair or replace packing (par. 51, 52).
	Oil leak at packing glands	Repair or replace packing (par. 51, 52).
	Leak in control valve	Check for worn or damaged plungers (par. 48).
	Leaks in oil lines	Tighten all connections or replace damaged lines.
Noisy Pump	Coupling misalignment	Re-align (par. 47).
	Pump head loose	Tighten (par. 47).
	Worn or broken parts	Replace (par. 47).
Oil Overheating	Internal oil leakage	Repair or replace pump (par. 47).
	Pump too tight after overhaul	Remove and repair (par. 47).
	Restricted lines	Check and repair.

Section II. ENGINE

9. Engine Assembly

a. *Description.* The engine is a conventional four-cylinder, four-stroke-cycle, gasoline operated valve-in-block type with a displacement of 133 cubic inches, which develops 35 brake horse power (bhp) at 2400 revolutions per minute (rpm), and 82 bhp at 1800 rpm. The four cylinders are cast in the single unit block and crankcase which comprise the main body of the engine. One complete stroke is required for each of the four cylinder actions: intake, compression, expansion and exhaust. One power stroke per cylinder for each two revolutions of the crankshaft.

b. *Removal.*

- (1) Remove seat, hood, rear fenders, rear grill, and counter-weight.
- (2) Disconnect radiator and hose connections to the engine (TM 10-3930-233-20).
- (3) Disconnect hydraulic lines at hydraulic pump (par. 47), and tie lines back away from engine.
- (4) Remove wiring harness from engine.

Note. For convenience and accuracy of installation, tag all terminals and leads to show installed position of leads.

- (5) Shut off fuel supply at shut off valve below fuel tank on left front side of truck. Disconnect fuel line from the fuel pump (TM 10-3930-233-20).
- (6) Disconnect all accelerator, shift and inching pedal linkages (TM 10-3930-233-20).
- (7) Disconnect universal joint (par. 35) at transmission end. Leave slip joint on output shaft to prevent oil leakage from transmission housing (37, fig. 27).
- (8) Disconnect exhaust pipe at manifold (TM 10-3930-233-20).
- (9) Disconnect any other accessory equipment which may be attached to engine and might interfere with removal (TM 10-3930-233-20).
- (10) Support engine and transmission assembly with a suitable hoist and sling.
- (11) Remove engine mount hardware (par. 21).

(12) Use hoist to raise engine enough to clear mounts then maneuver engine free of compartment and lift free of truck.

(13) Remove transmission assembly (par. 28) if it will interfere with projected work on engine.

b. Installation.

(1) Install engine assembly in reverse order of removal.

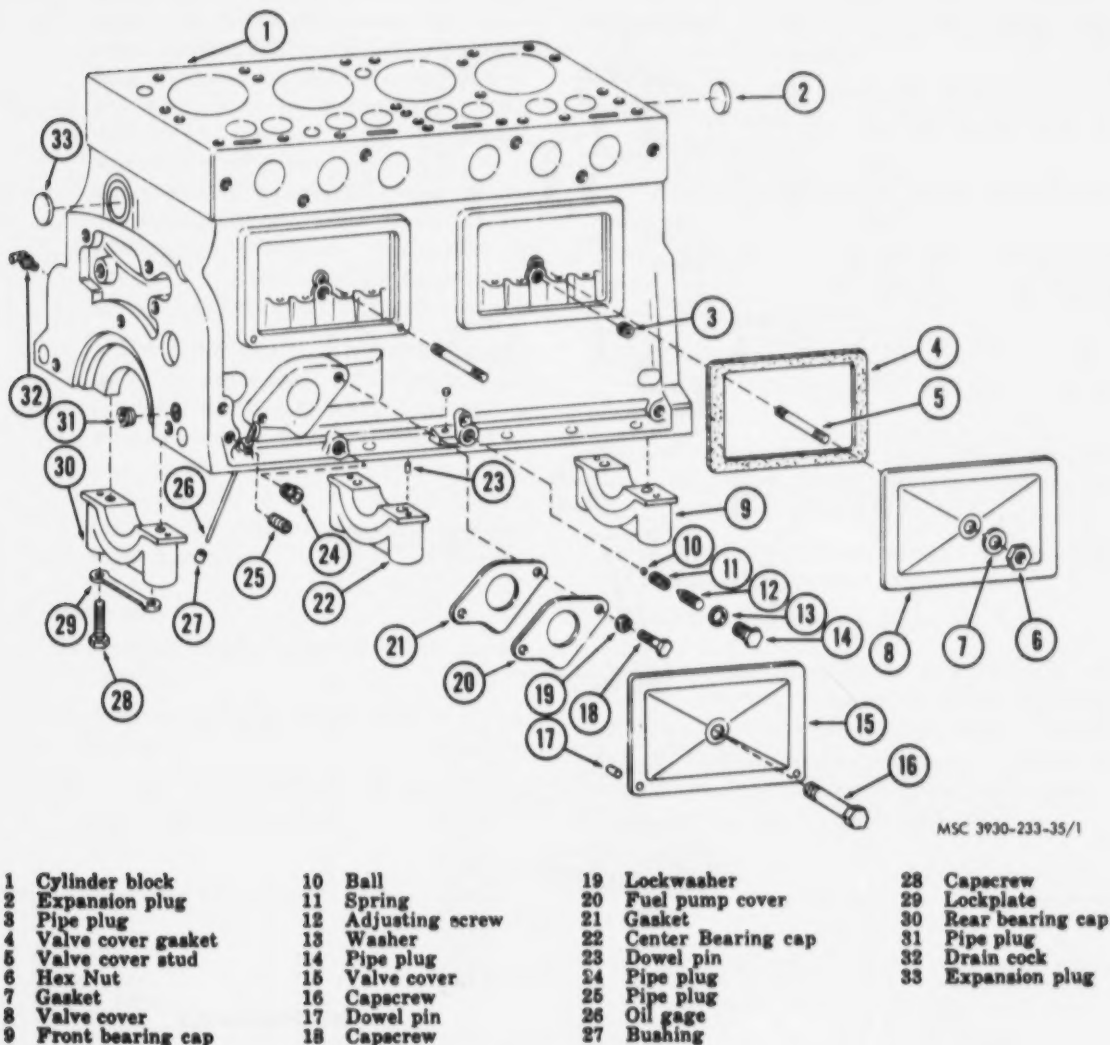
(2) Use extreme care in maneuvering engine and transmission assembly into truck to prevent any damage.

(3) Refer to TM 10-3930-233-20 for installation of engine accessories, lines and linkages.

10. Cylinder Head, Cylinder Block, and Crankcase

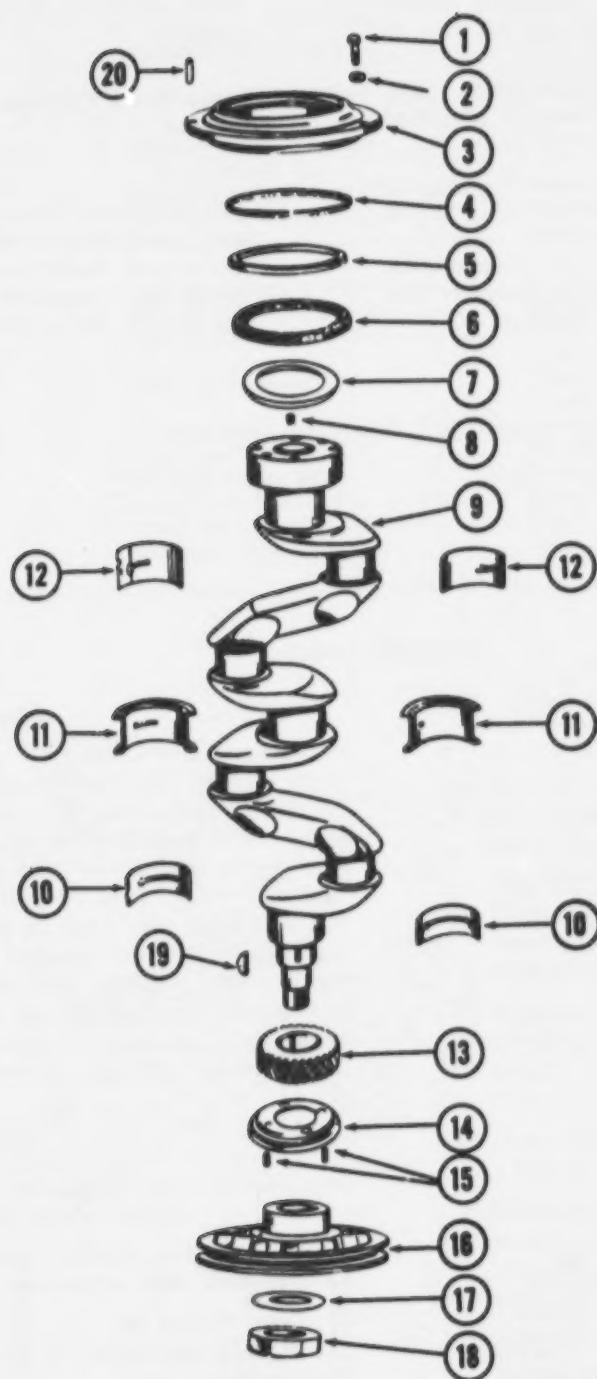
a. Description.

(1) Cylinder Head. The cylinder head is an alloy cast iron unit which is secured to the cylinder block by specially hardened studs and capscrews. The head seals the top of the cylinders to form the



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Figure 1. Cylinder block and crankcase.



MSC 3930-233-35/2

Figure 8. Crankshaft components.

combustion chambers and to provide passages of the air-fuel mixture intake, and exhaust gas expulsion. Cored water passages are provided for coolant flow. The fan end of the cylinder head is flanged to provide a mount for the water pump.

- (2) Cylinder Block and Crankcase. The single unit cylinder block and crankcase contains generously filleted bearing cross walls and water baffles. The bores are exposed to coolant for their entire lengths. Intake and exhaust ports are arranged along the upper right side of the engine over the valve cover openings. The crankcase is ribbed lengthwise along the lower portion of the same side to incorporate a rifle drilled oil passage. An adjustable, spring loaded pressure relief valve is mounted just below the center of the oil passage to provide a means of adjusting oil pressure. An outlet to supply oil to the governor is provided toward the front end of the oil passage.

The front end of the crankcase provides an accurately machined surface for mounting the flywheel housing. A semi-circular groove in the flywheel face of the crankcase contains a seal gasket and receives a circular closure plate which seals off the crankcase and main bearings.

b. Removal.

- (1) Remove engine assembly from truck (par. 9).
- (2) Remove cylinder head (TM 10-3930-233-20).
- (3) Remove flywheel (par. 17), and crankshaft pulley (par. 11).

Caution: Be careful not to mix flywheel bolts with others. They are special and must not be replaced by ordinary bolts.

- (4) Drain oil from oil pan, and turn engine upside down.

Caution: Use great care that the machined surfaces of the cylinder and its internal parts are protected from dirt and damage.

- (5) Remove oil pan cap screws, and remove oil pan (par. 19).
- (6) Remove the front main bearing closure plate (3, fig. 2), the cork gasket (4), and felt seal (6).
- (7) Remove the governor (par. 23) and disconnect the lubricating oil line at the block.
- (8) Remove the timing gear cover (par. 16).
- (9) Remove the connecting rod bearing caps (par. 12), and the three main bearing caps (par. 11).
- (10) Remove crankshaft (par. 11) with great care to prevent damage to journals.
- (11) Remove camshaft (par. 15) being certain not to scratch bushings during removal.
- (12) Remove valves, springs, guides and camfollowers (par. 14).
- (13) Remove oil pump (par. 18).

c. *Installation.* Installation is essentially the reverse of removal procedures with the addition of the adjustments necessary for the many parts and engine accessories which are listed in the appropriate paragraphs of the TM 10-3930-233-35, and in TM 10-3930-233-20.

1 Capscrew	6 Oil seal	11 Center bearing shell	16 Crankshaft pulley
2 Lockwasher	7 Oil Thrower	12 Rear bearing shell	17 Shim (as needed)
3 Closure plate	8 Pipe plug	13 Crankshaft gear	18 Nut
4 Gasket	9 Crankshaft	14 Oil thrower	19 Key
5 Oil seal cup	10 Front bearing shell	15 Screw	20 Dowel pin

Figure 2.—Continued.

11. Crankshaft, Bearings and Timing Drive Gear

a. Description. The crankshaft is a heat treated steel forging, drilled for pressure lubrication of the connecting rods and main bearings. End thrust is controlled by flanges on the center main bearing. The timing drive gear is keyed and pressed in place and supports on oil slinger ring. An oil slinger is also pressed in place on the flywheel end of the crankshaft. The fan belt pulley is keyed and pressed on the portion of the crankshaft protruding through the timing drive gear.

The precision type main bearing consist of thin wall bearing shells held in place by precision machined bearing seats and caps.

b. Removal.

- (1) Remove engine assembly from truck (par. 9).
- (2) Remove engine accessories (TM 10-3930-233-20).
- (3) Remove governor (par. 23).
- (4) Remove cylinder head and water pump as an assembly only if necessary to work on cylinders, valves, cooling or manifold passages (par. 10).
- (5) Remove valve covers plates (par. 14) only if necessary to work on valve assembly or camshaft.
- (6) Remove flywheel by removing lock-wires and the specially hardened bolts (par. 17).
- (7) Drain oil and remove oil pan (par. 19) then turn engine upside down.

Caution: Be careful to protect machined surfaces, moving parts, and openings from dirt and damage.

- (8) Remove front main bearing closure plate (3, fig. 2) by removing the three capscrews (26) and washers (27).
- (9) Remove the crankshaft pulley (16) and key (19) by removing nut (18) and pulling with gear puller.
- (10) Remove timing gear cover (par. 16).
- (11) Remove the connecting rod bearing caps (par. 12).

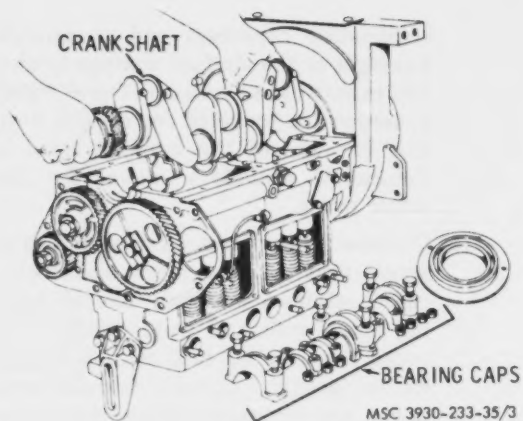


Figure 3. Crankshaft removal.

- (12) Flatten the main bearing cap lock strips (29, fig. 1) and remove main bearing bolts and caps (28, 9, 22, 30).
- (13) Remove thin wall outer bearing shells (10, 11, 12, fig. 2).
- (14) Carefully lift the crankshaft from the bearing seats. Avoid nicking or bumping the bearing or journal surfaces while handling (fig. 3).
- (15) Use a gear puller to remove the crankshaft timing gear (13, fig. 2) and key (19).

c. Cleaning.

- (1) Clean all parts with SD (solvent, dry-cleaning) and dry thoroughly.
- (2) Remove all dirt and foreign matter from inside the bearing caps.
- (3) Using a soft wire probe, clean all clogged passages.

d. Inspection.

- (1) Inspect crankshaft journals and bearings for excessive wear, scoring, taper, out-of-round, and other possible damage. The maximum allowance for taper and out-of-round is 0.001 inch. The minimum allowable diameter for the main bearing journal is 2.8725 inches. The maximum allowable diameter for these journals is 2.8730 inches. Replace defective crankshaft as authorized.

- (2) Inspect timing drive gear (13, fig. 2) for cracks and damaged or broken teeth.
- (3) Inspect seats, thin wall bearing shells, and bearing caps for excessive wear, scoring, cracks and breaks. Replace defective parts as authorized.

e. Assembly and Installation.

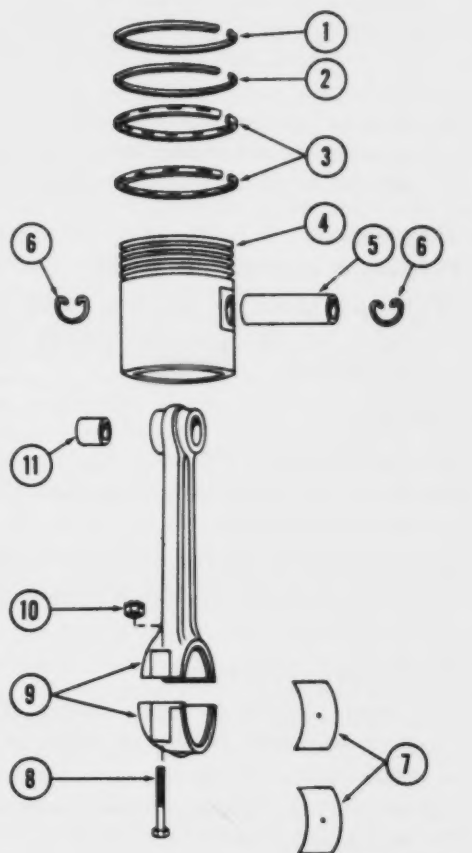
- (1) Assembly and installation are the reverse of disassembly and removal procedures.
- (2) Be sure that bearing seat on absolutely clean surfaces and that the back of the bearings are wiped perfectly clean. The slightest bit of dirt or carbon squeezed between the backs of the thin walled bearing shells and their seats can cause rapid bearing failure by developing a localized high spot.
- (3) Correct tension on the bearing bolts, for the main bearings, and nuts on the connecting rod bearings, is mandatory for obtaining maximum bearing life.
- (4) Use a torque wrench, alternating from one side of bearing to the other. Apply final tension using a slow steady pull and hold wrench on torque for a few seconds to ensure correct torque values.
- (5) Correct torques are, 88 - 92 foot-pounds for the main bearing, and 44 - 46 foot-pounds for the rod bearings.

12. Pistons and Connecting Rods

a. Description. The engine has four aluminum alloy pistons. Each piston has two compression rings and two oil rings. Each piston is attached to a connecting rod by a piston pin. The forged connecting rods are precision ground at the large end to receive precision type thin wall bearing shells. A bronze bushing is diamond bored and burnished, in place, in the upper end of the connecting rod. Pistons and rings are available in 0.020, and 0.040 inch oversizes to provide correct tolerances when cylinders are bored and honed.

b. Removal.

- (1) Remove cylinder head from engine (TM 10-3930-233-20).
- (2) Using a suitable reamer, remove ridge from top of cylinder walls before removing pistons. Failure to remove ridge will result in damage to piston ring lands.



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- | | |
|--------------------------|------------------|
| 1 Upper compression ring | 9 Connecting rod |
| 2 Lower compression ring | 10 Marsden nut |
| 3 Oil ring | 11 Bushing |
| 4 Piston | |
| 5 Piston pin | |
| 6 Retaining ring | |
| 7 Bearing shells | |
| 8 Bolt | |

Figure 4. Piston and Connecting Rod.

- (3) Remove reamer cuttings.
- (4) Drain and remove oil pan (par. 19).
- (5) Turn crankshaft until one of the pistons is at the top of its stroke.
- (6) Remove nuts and bolts (8, 10, fig. 4), then remove bearing caps and shells, (9, 7).

Caution: Be certain to mark cap shells and connecting rods (9) for accurate rematching during assembly. Mismatching can cause serious damage.

- (7) Remove piston and connecting rod through top of cylinder block. Be certain not to damage rings or grooves.

c. Disassembly.

- (1) Remove ring set from piston.
- (2) Remove piston pin retainers (6, fig. 4), piston pin (5), and piston from connecting rod.

d. Cleaning.

- (1) Soak pistons in SD.
- (2) Clean all carbon from top and ring grooves of piston.
- (3) Use a drill of appropriate size to clean carbon from the oil return holes in the grooves.

e. Inspection and Repairing.

- (1) Inspect pistons for score marks, ring land fractures, cracks, or other damage.
- (2) Measure each piston with a micrometer to determine size.
- (3) Inspect pins, rods, and rings for cracks, scores, distortion and other damage.
- (4) Place ring in bore of cylinder, invert piston and use it to push the ring to within two inches of the top of the cylinder.
- (5) Measure ring gap with a feeler gauge. The gap should be 0.010 to 0.020 inch. If the gap is smaller than 0.010 inch, remove ring from bore and file ends of ring until the desired gap is obtained.

- (6) Install fitted rings on the pistons to be used in the specific bore in which the ring gap test was performed. Install the oil rings (3, fig. 4) in the two lower grooves on the piston, and the two compression rings (1, 2) in the two upper grooves. Refer to Figure 4 for correct placement.

- (7) Check compression rings for proper side clearance, between rings and sides of the piston grooves. The clearance should be from 0.002 to 0.0035 inch for both compression rings. If the side clearance is less than 0.002 inch, lay a piece of fine emery cloth on a flat surface and rub the ring lightly there on until desired clearance is obtained. If side clearance exceeds 0.0035 inch, replace ring.

- (8) Oil ring side clearance should be 0.0015 to 0.003 inch.

- (9) Measure piston pin clearance in piston. Design tolerance is from 0.0001 to 0.0003-inch loose. If too tight, ream out pin holes.

- (10) Measure piston pin clearance in the connecting rod bushing. The desired clearance is from 0.0001 to 0.0005-inch loose. If too tight, ream bushing. If too loose, replace bushing.



Figure 5. Checking Piston Clearances.

(11) Room temperature measurement of the running clearance between piston and bore must be accurate.

- (a) Select a piece of 0.5 inch wide feeler gauge stock 8 to 10 inches long and 0.003 inch thick. This feeler stock must be perfectly flat and free of nicks or scratches. Attach feeler gauge to an accurate spring scale having a ten pound full scale reading.
- (b) Hold feeler gauge along the side of cylinder bore then insert piston and rod assembly in to bore in normal running position. Face one end of piston pin to gauge.
- (c) A maximum pull of eight pounds should withdraw the feeler gauge from between piston and bore.
- (d) Repeat (b) and (c) above at three more points 90 degrees apart around the cylinder bore.
- (e) Repeat (b), (c), and (d) above at both ends of the cylinder bore to insure equal diameters at top and bottom of bore.

f. Assembly and Installation.

- (1) Oil cylinder wall and pistons with OE (Lubricating oil internal combustion engine).
- (2) Be certain that ring gaps are equally spaced around the circumference of the pistons.
- (3) Compress rings with ring compressor, tapping the compressor lightly around the rings to allow the rings to close evenly.
- (4) Use a wooden hammer handle to force piston through the ring compressor into the cylinder bore. Keep the ring compressor tight against the cylinder block to prevent ring damage.
- (5) Oil crankshaft journal with OE, install upper half of bearing shell into connecting rod, and seat bearing on crankshaft journal.
- (6) Install lower half of connecting rod bearing shell in connecting rod bear-

ing cap and install cap, nuts, and cotter pins.

- (7) Use 44 to 46 foot-pounds of torque to the connecting rod bearing cap nuts.
- (8) Replace oil pan (par. 19) and cylinder head (TM 10-3930-233-20).

13. Bearings and Adjustments

a. General. Both the connecting rod and main bearings are of the steel-backed, precision type. Due to the close machining of this type of bearing, no fitting, filing, scraping, boring, or other adjustment is required or permissible. Replacement must be in complete bearing units. Never replace only one half of a bearing. Service bearings are available in standard size only. Never attempt to adjust a bearing by filing, grinding, or lapping the bearing cap. The bearing seats are precision ground with the caps in place. Any metal removed from either side prevents the proper fit of a connecting rod bearing in the rod, and in the case of a crankcase, makes the entire crankcase unsuited for further use. Be sure the bearings seat on absolutely clean surfaces and that the back of the bearings are wiped perfectly clean. The slightest bit of dirt or carbon squeezed between the back of a bearing and its seat can cause rapid bearing failure by developing a localized high spot. Equally important in obtaining maximum bearing life is the correct tension on the connecting rod bearing cap nuts. Pull down on all nuts evenly, going from one side of the bearing to the other. Apply final tension with a torque wrench using a slow steady pull and holding the wrench "on torque" for a few seconds when the proper value is reached. It is preferable to go to a slightly higher tension if necessary. Previous over torquing or some other damage to the bolt or nut is sometimes encountered and will be felt by the torque "softening up" so that the nut can be turned without any appreciable increase in wrench tension. Never allow a bolt or a nut in this condition to remain in the engine.

b. Main Bearing Crush. The term "crush" is generally understood to mean the projection of the bearing edges above flush with the mating surfaces of the bearing seat and cap. This crushing action forces the bearing halves into

close contact with their seats for greater rigidity and good heat conduction. The correct amount of crush has been allowed during the manufacture of the bearings and no attention to that detail is necessary at the time of replacement. The use of a torque wrench for tightening bearings is necessary to insure sufficient "crush" on the bearings to force the shells against the crankcase metal without distortion.

c. Running Clearances. Even in the case of precision bearings, it is good mechanical practice to check running clearances when installing bearings. There are several methods of doing this, some of which are merely checks of whether any clearance exists and others that give an indication of how much clearance is present. The familiar test of connecting rod bearing clearance consists of manually gripping the rod cap after the bearing bolts are tightened and attempting to move the rod from side to side in the direction of end clearance. A well fitted bearing is usually just loose enough to be "snapped" from side to side without actually feeling so loose as to push easily. Sometimes a slightly snug bearing will not move under pressure but will move readily under light blows from a soft faced hammer. This is usually considered satisfactory providing the engine is given adequate break-in time. Generally the test on main bearings consists of tightening each bearing cap in turn and turning the crankshaft to detect binding. One accurate test is:

- (1) Use fuse wire or a special crushing gauge material (Do not use acid or rosin core solder).
- (2) Place crushing gauge between shaft and bearing, then tighten bearing in place using the normal torques of 88-92 foot-pounds for connecting rod bearings.
- (3) Remove cap and shell, remove crushing gauge material, gently, and use a micrometer to check for correct clearance. It is emphasized that any unusual bending or runout in a crankshaft makes it impossible to fit bearings accurately. For this reason, the time spent in making a run-out check is well worth while. Also, magnetic

inspection of the crankshaft and other stressed parts is recommended if the proper equipment is available.

Do not forget to coat all running surfaces with clean, fresh engine oil when installing bearings.

d. Field Replacement of Main Bearings. In an emergency a main bearing may be replaced without removing the crankshaft. This type of repair is to be confined to emergency field conditions.

- (1) Remove the bearing cap and its bearing shell.
- (2) Place a soft brass or aluminum strip against an exposed edge of the upper bearing shell, and firmly push the shell around the crankshaft journal.
- (3) Inspect and replace both shells as necessary, never replace one alone.
- (4) Inspect journal surface for roughness, out of round, or undersize; any of which greatly reduce bearing life.

For best performance and reliability it is recommended that the crankshaft be removed so that adequate inspection and checks, for conformance to design tolerances may be performed.

14. Valves, Springs, Guides and Lifters

a. Description. The valve lifters and valves are of the conventional mushroom type. Valve springs are held to the valve stem by a pair of wedge shaped retainers (6, fig. 6) between the stem and spring retainer cup. The valves operate in replaceable guides and seats.

b. Valves and Springs.

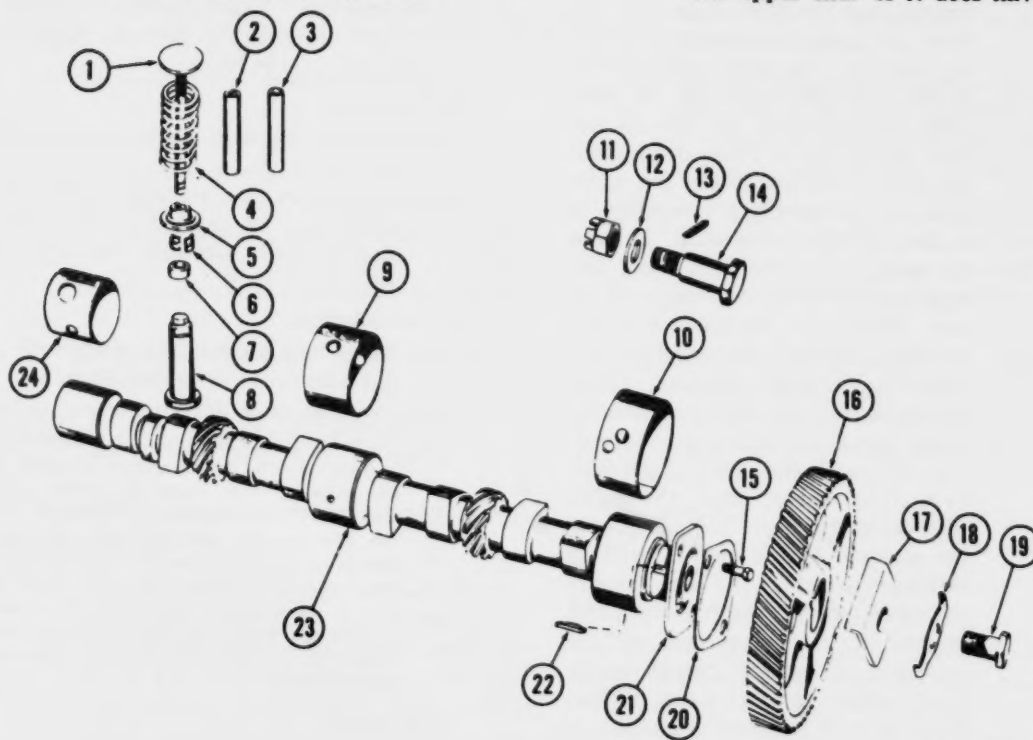
- (1) Removal.
 - (a) Remove cylinder head (TM 10-3930-233-20).
 - (b) Remove valve covers on side of engine block (TM 10-3930-233-20).
 - (c) Raise spring retainer cup (5, fig. 6) until the two wedge shaped retainers (6) drop out from between the cup and valve stem.

- (d) Lift valves (1), retainer cups (5), retainers (6), and springs (4), out of engine.
- (e) Place valves in numbered holes in a board to make sure of reinstallation in their original positions.
- (2) Inspection and Cleaning.
 - (a) Examine valve carefully for fit in guide, excessive wear, warping or burning.
 - (b) Remove all carbon and burnt oil.
 - (c) Inspect spring coils for bright spots that may be an indication of weakness when found beyond the closely spaced damping coils at the spring ends.
 - (d) Check tension of each valve spring with a suitable spring scale.

- (e) Tension of all springs should be equal. Spring free length is $2\frac{1}{4}$ inch. Compressed to $1\frac{29}{32}$ inch the scale should read approximately 36 pounds.
- (f) Replace defective parts as authorized.

(3) Grinding.

- (a) The accuracy of grinding valve seats depends upon the condition of the valve guide and the pilot mandrel's fit, both in the guide itself, and the hub of the grinder stone. It is vitally important to make sure that the mandrel is a snug fit in the valve guide, and does not wobble at the upper end. If it does have any



MSC 3930-233-35/6

- | | | |
|-------------------------|-------------------------|-----------------|
| 1 Valve | 9 Center bushing | 17 Lock plate |
| 2 Valve guide (intake) | 10 Front Bushing | 18 Screw lock |
| 3 Valve guide (exhaust) | 11 Nut | 19 Lock screw |
| 4 Spring | 12 Washer | 20 Lock plate |
| 5 Retainer | 13 Cotter pin | 21 Thrust plate |
| 6 Lock | 14 Idler gear plug | 22 Woodruff key |
| 7 Cap | 15 Cap screw | 23 Camshaft |
| 8 Tappet assembly | 16 Camshaft timing gear | 24 Rear bushing |

Figure 6. Camshaft, valves and lifters.

upper end movement the seat will not be ground true.

- (b) Guides that are worn too much to give the mandrel solid support should be replaced before grinding is attempted. The manufacturers instructions for dressing the grinding wheel must be followed to secure smooth, accurate seats.
- (c) Before grinding valves make sure the valve stems and guides are a good fit, within tolerances, to ensure a concentric seat and a tight valve.
- (d) Apply a good, medium grinding compound sparingly around the entire valve seat, slip a light lifting spring over the stem, lubricate the stem and place the valve in its original position. The spring should just barely hold the valve off its seat. Place the grinding tool cup on the head of the valve. Press down until the valve is seated. Turn the valve until all the grinding compound is rubbed off the valve seat. Release the pressure on the valve and the light spring will lift it clear of its seat. Withdraw the valve and put on fresh grinding compound and repeat the grinding operation. Clean the valve and its seats occasionally to see how the grinding is progressing. When all the pits and grooves have disappeared, clean the valve and valve seat, and place eight or ten equally spaced marks with a soft lead pencil on the seat. Insert the valve, give it a quarter turn, and remove it. A perfect seat will be indicated if every pencil mark shows where the valve has rubbed it. If any of the pencil marks are left untouched, continue the grinding. When the grinding is completed, check the valve seat for concentricity with a dial indicator. Clean all traces of grinding compound from the valve chamber and ports, oil the valve stem and install. Remember to install each valve in

the same position from which it was taken.

(4) Installation.

- (a) Insert valve in guide and seat to which it has been fitted.
- (b) Install spring and retainer cup, compress spring and insert wedge shaped retainers between concave side of retainer cup and groove in valve stem.
- (c) Releasing spring holds retainers in place and holds spring on stem.
- (d) Replace valve covers (par. 10) and cylinder head (TM 10-3930-233-20).

c. Guides.

- (1) Description: Valve guides are tubular inserts designed for press fit insertion into the engine block.

(2) Removal:

- (a) Using a suitable puller, remove old guides (2, 3, fig. 6).
- (b) In absence of a suitable puller, the guide may be reamed to leave only a thin shell. Collapse the shell to remove.

(3) Installation.

- (a) Press new guides into place with a suitable arbor press and mandrel.
- (b) Press guide in until upper end is 1.0 inch from the face of the crankcase.

Note. Special notice should be taken of the exhaust valve guide and valve stem shoulder. The guide should not project into the gas passage and the stem shoulder should be sharp and located slightly below the end of the guide when the valve is seated. Thus any accumulation of carbon around the guide and stem running surfaces will be sheared away each time the valve is lifted.

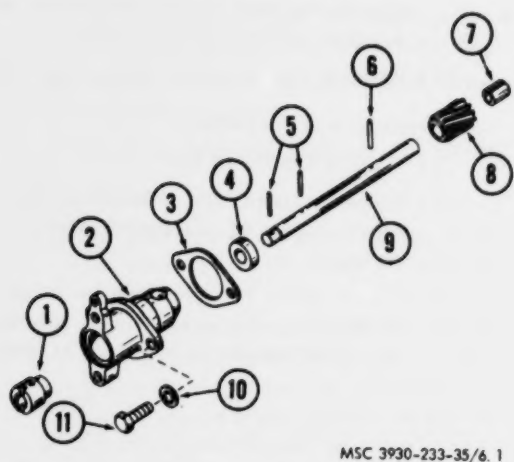
d. Valve Lifters.

(1) Removal.

- (a) Remove camshaft (par. 15).
- (b) Remove valve lifters (8, figure 6) through bottom of crankcase.

(2) Inspection and Cleaning.

- (a) Soak in SD and remove any foreign material.



MSC 3930-233-35/6. 1

1 Coupling	5 Roll pin	9 Shaft
2 Body	6 Pin	10 Lockwasher
3 Gasket	7 Bushing	11 Capscrew
4 Collar	8 Drive gear	

Figure 7. Distributor drive assembly.

- (b) Inspect for warping, cracks, wear or other damage.
- (c) When worn or damaged lifter is found always check camshaft lobe (par. 15). Valve lifter running clearance in the crankcase is 0.0005" to 0.002".
- (d) Replace damaged parts as authorized.

- (3) *Installation.* Oil the lifter and check it for free movement in the block.

15. Camshaft, Bushings, Gears, and Seals

a. Description.

- (1) The camshaft runs in steel backed babbit shells located in the three main crankshaft bulkheads. The camshaft drive gear is pressed and keyed on the read end of the camshaft. Two spiral gears are provided, one to drive the oil pump and the other to drive the distributor. An eccentric toward the front of the camshaft actuates the diaphragm type fuel pump. Camshaft end play is controlled by a thrust plate located between the shoulder of the rear cam journal and the face of the camshaft gear hub.

b. Bushing Removal.

- (1) Remove oil pan, (par. 19), distributor (TM 10-3930-233-20), oil pump (par. 18), timing gear cover (par. 16), and valve covers (TM 10-3930-233-20).
- (2) Raise valves and springs (1, 4, fig. 6), and keep them raised with wooden blocks or other suitable means.
- (3) Raise tappets (8) to clear cam lobes on shaft. Keep tappets raised with tape, wire, cord or by other suitable means.
- (4) Remove the two capscrews (15).
- (5) Gently withdraw camshaft from its bushings.

Caution: Do not allow cam lobes to catch or, be scratched by, or scratch, bushings or case.

- (6) Remove camshaft bushings from cylinder block by using suitable puller, or ream bushings until they are thin enough to collapse and remove.
- (2) Check camshaft end play by mounting thrust plate and timing gear on shaft and measuring distance between shaft journal and thrust plate with feeler gauge.
- (3) If measurement exceeds 0.006 inch, replace thrust plate with one of suitable thickness to provide 0.002 to 0.006 inch clearance between journal and thrust plate.

d. Installation. Reverse procedure in b above.

16. Timing Gears and Cover

a. Description. The timing gear group consists of the crankshaft gear, camshaft gear, and governor gear. The gears are located under the timing gear cover behind the fan belt drive pulley.

b. Removal.

- (1) Remove hydraulic pump assembly (par. 47).
- (2) Remove crankshaft fan belt drive pulley by removing nut (18, fig. 2) and using suitable wheel puller.

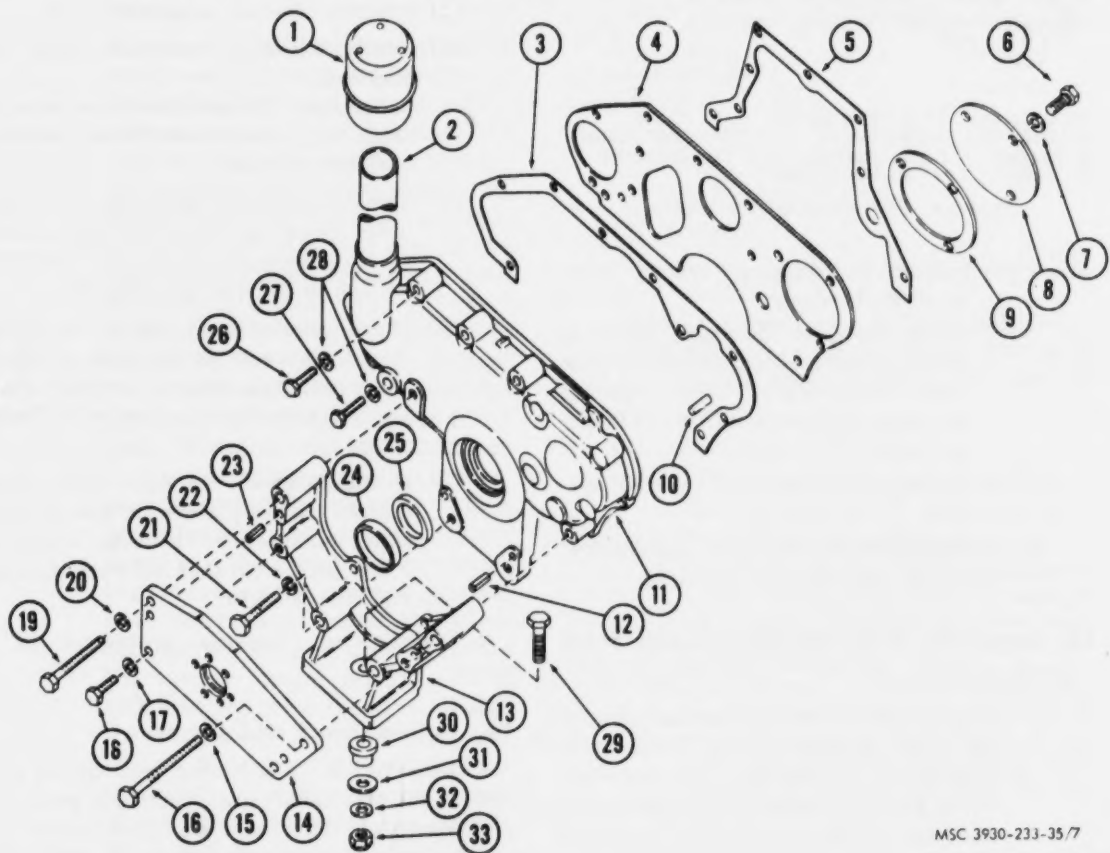
- (3) Remove timing gear cover (11, fig. 8) by removing capscrews (26, 27).
- (4) Remove camshaft and crankshaft gears by removing capscrew, lock, and lock plate (19, 18, 17, fig. 6), and nut (18, fig. 2).
- (5) Remove oil slinger (14, fig. 2) from crankshaft. Use suitable gear pullers to pull gears from shafts.
- (6) In the absence of suitable gear puller, the gears may be removed (and destroyed in the process) by drilling at the keyway and splitting the gear. In

this case be sure to drill directly above the key so that any drilling error will damage the key not the shaft.

- (7) Remove the governor gear (par. 23).

c. Cleaning and Inspection.

- (1) Wash all parts in SD.
- (2) Inspect gears for cracks, chips or other signs of excessive wear and damage.
- (3) Check gears for backlash of 0.002 to 0.004 inch. Looser fits are tolerable provided looseness is not so excessive



MSC 3930-233-35/7

- | | | | |
|---------------------|------------------|---------------|-----------------|
| 1 Breather cap | 10 Dowel pin | 19 Capscrew | 28 Lockwasher |
| 2 Oil filler tube | 11 Gear cover | 20 Lockwasher | 29 Capscrew |
| 3 Gear cover gasket | 12 Roll pin | 21 Capscrew | 30 Engine mount |
| 4 Front plate | 13 Front support | 22 Lockwasher | 31 Flat washer |
| 5 Gasket | 14 Pump plate | 23 Dowel pin | 32 Washer |
| 6 Capscrew | 15 Lockwasher | 24 Retainer | 33 Locknut |
| 7 Lockwasher | 16 Capscrew | 25 Oil seal | |
| 8 Cover | 17 Lockwasher | 26 Capscrew | |
| 9 Gasket | 18 Capscrew | 27 Capscrew | |

Figure 8. Timing gear cover.

as to cause chatter. A slightly loose fit is preferable to an over tight fit.

- (4) Inspect cover for cracks, dents, breaks and other damage.
- (5) Replace defective parts as authorized.

d. Installation.

- (1) Reverse procedures in *b* above, except for installation of gears on cam and crankshafts.
- (2) Heat cam and crankshaft gears to approximately 450° F. in an oil bath. Use a driving sleeve to tap gear snugly in place. Hard driving is not normally necessary and indicates the gear is too cold or cocked on shaft.
- (3) Install governor gear (par. 23).

17. Flywheel, Ring Gear, and Housing

a. Description. The flywheel is bolted and dowelled to flange on the front end of the crank-

shaft. Offsetting of one of the capscrews assures the flywheel being attached in a predetermined position on the crankshaft flange. The starter ring gear is shrink fit to the flywheel.

The flywheel housing is capscrewed to a machined surface on the front of the engine block. An opening, with cover, is provided in the right side of the housing through which the timing marks on the flywheel may be seen. Two engine mount flanges are integrally cast as part of the flywheel housing.

b. Removal.

- (1) Remove engine assembly from truck (par. 10).
- (2) Remove transmission from engine (par. 28).
- (3) Remove the lockwires from the four bolts (18, fig. 9) and remove bolts and washers holding flywheel to flange.

Caution: Do not mix special flywheel retaining bolts (18) with others. Do not use ordinary bolts, since flywheel bolts are under great stress in normal use.

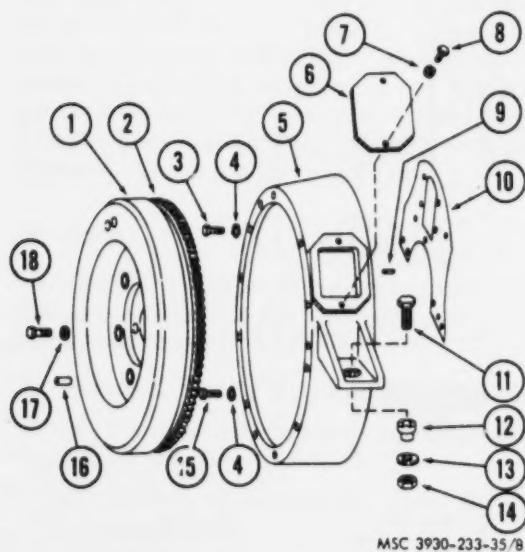
- (4) Remove flywheel (1).
- (5) Use gear puller to remove starter ring gear (2) if necessary.
- (6) Remove the three capscrews holding the main bearing assembly closure (3, fig. 3) and remove closure.
- (7) Remove the five capscrews (3, fig. 9) holding the flywheel housing (5) to the cylinder block and remove housing.

c. Cleaning and Inspection.

- (1) Clean all parts with SD and remove any foreign material.
- (2) Check flywheel and housing for run-out, cracks or other damage.
- (3) Check ring gear for cracks, chipped teeth, and other damage or wear.
- (4) Replace damaged parts as authorized.

d. Installation.

- (1) Installation is performed in reverse order of removal.



MSC 3930-233-35/8

- | | |
|---------------------|-------------------|
| 1 Flywheel assembly | 10 Housing gasket |
| 2 Ring gear | 11 Capscrew |
| 3 Capscrew | 12 Engine mount |
| 4 Lockwasher | 13 Flat washer |
| 5 Housing | 14 Locknut |
| 6 Inspection cover | 15 Capscrew |
| 7 Lockwasher | 16 Dowel pin |
| 8 Capscrew | 17 Lockwasher |
| 9 Dowel pin | 18 Capscrew |

Figure 9. Flywheel, ring gear, and housing.

- (2) Flywheel bolts should be tightened to 66 to 69 foot-pounds.

18. Oil Pump

a. Description. The lubricating oil pump is of the positive driven gear type, consisting of a single cast pump housing and mounting extension with a precision cavity to receive the two pump gears. An idler gear shaft is pressed in place in the pump body. The drive gear shaft extends the length of the pump body extension and carries a gear at its upper end to mesh with the spiral drive gear towards the front of the camshaft.

The oil is picked up by the set of gears, is passed around the gears, and forced up the pump body extension between the body and shaft. The oil enters the engine shortly above the point where the extension enters the crankcase on the left side of the engine. The lower section of the pump is surrounded by a filter screen to provide protection to the gears.

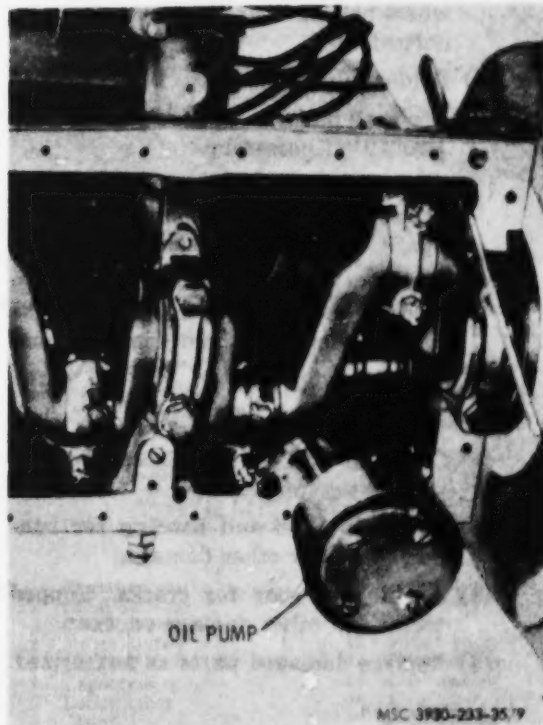
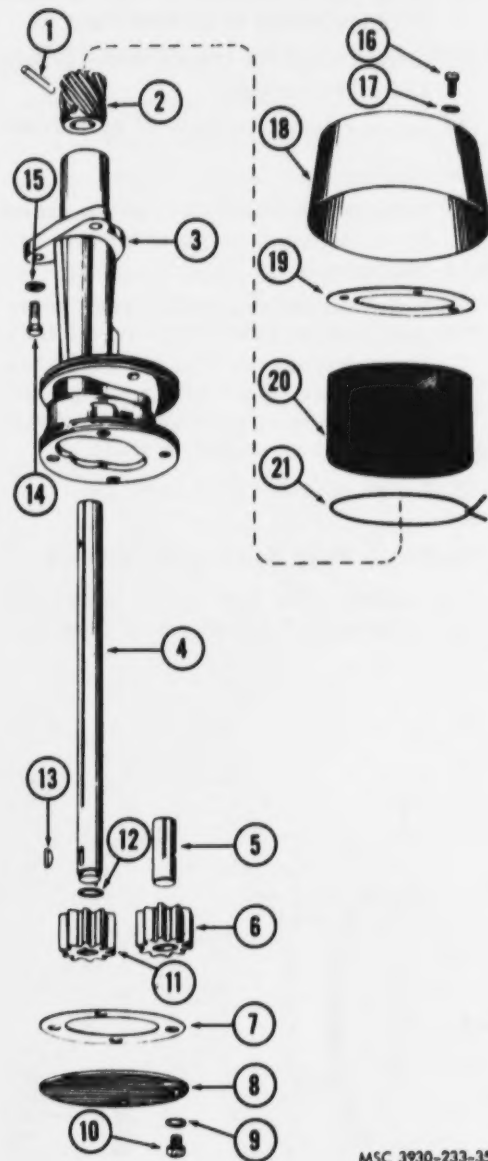


Figure 10. Oil Pump Location.



MSC 3930-233-35/10

- | | |
|------------------|------------------|
| 1 Roll pin | 12 Ring |
| 2 Spiral gear | 13 Woodruff key |
| 3 Oil pump assy | 14 Capscrew |
| 4 Drive shaft | 15 Lockwasher |
| 5 Idler shaft | 16 Machine screw |
| 6 Driven gear | 17 Lockwasher |
| 7 Gasket | 18 Baffle |
| 8 Cover | 19 Gasket |
| 9 Lockwasher | 20 Screen |
| 10 Machine screw | 21 Wire |
| 11 Drive gear | |

Figure 11. Oil pump, exploded view.

b. *Oil Pump Removal.*

- (1) Drain oil from oil pan.
- (2) Remove oil pan (par. 19).
- (3) Remove the two capscrews (14) holding the oil pump to the flange of the crankcase, and withdraw pump.

c. *Cleaning and Inspection of Oil Pump.*

- (1) Wash oil pump in a SD and carefully inspect.

Note. The principal wearing parts of the oil pump are the gears. If dirt or sludge have been allowed to accumulate in the lubricating system, the oil pump gear wear may be rather pronounced in a comparatively short time. When the oil has been kept clean and oil filter has been properly serviced, the wear on these parts will be very slow.

- (2) Both the spiral drive gear on the pump drive shaft and the mating gear on the camshaft, should be checked for proper contact and evidence of excessive wear, pitting or chipping.

d. *Installation.* Reverse the removal procedure. Make sure spiral drive gear (2) and mating gear on camshaft are properly meshed. Install the attaching lockwashers (15) and capscrews (14). If the oil pump is not properly seated, it is possible to break the retaining lugs from the body casting when the capscrews are tightened. Check for this condition.

19. Oil Pan

a. *Description.* The oil pan is a single unit stamping attached to the underside of the engine by capscrews.

b. *Removal.*

- (1) Drain oil pan by removing drain plug (9, fig. 12).
- (2) Remove capscrews (6) from the oil pan flange.
- (3) Remove oil pan from block.

Caution: Do not use screw driver or other prying tool to loosen oil pan from block. If normal pressure does not loosen pan, several sharp raps with a rawhide or plastic mallet will do the job. Prying may damage the flange

and probably cause leaks around the gasket.

- (4) Discard damaged gaskets.

c. *Inspection and Cleaning.*

- (1) Clean with SD.
- (2) Inspect for dents, cracks, tears, nicks in flange, or warping which would interfere with oil pan remaining leak proof.
- (3) Repair or replace as authorized.

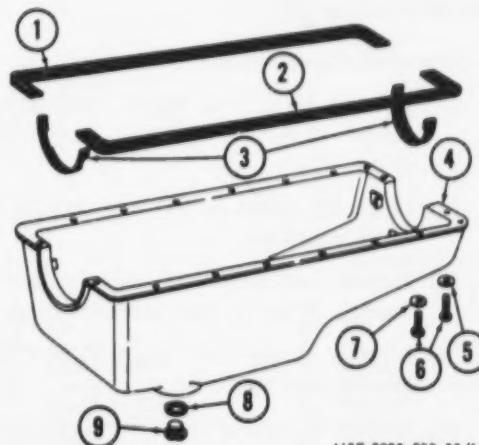
d. *Installation.*

- (1) Reverse removal procedures.
- (2) Use new gaskets.

20. Oil Relief Valve

a. *Description.* Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of oil temperature, by means of a regulator valve located on the left side of the crankcase directly below the carburetor and in registration with the horizontal oil gallery.

The valve assembly consists of a ball, compression spring, adjusting screw, and cap.



MSC 3930-233-35/11

- | | |
|-----------------|-----------------|
| 1 Gasket | 6 Capscrew |
| 2 Gasket | 7 Lockwasher |
| 3 End gasket | 8 Gasket |
| 4 Oil pan | 9 Magnetic plug |
| 5 Copper washer | |

Figure 12. Oil pan.

The ball is held on its seat by the spring, which is held in compression by the adjusting screw in the valve opening in the crankcase. It is sealed against leaks by copper gaskets. When conditions are such that the oil pressure at the valve exceeds 15-25 p.s.i., the ball is lifted off its seat and oil from the main gallery is by-passed to the engine oil pan.

b. Pressure Regulator Service. Under normal conditions, the valve should require very little attention. If the lubricating system has been allowed to sludge up, the regulator valve may not work freely, thereby remaining open or failing to open.

Whenever the lubricating oil pump is removed for repairs or inspection, the regulator valve should also be disassembled, thoroughly cleaned and parts inspected.

Whenever a valve adjustment is necessary it should be done AFTER the engine and oil have reached normal operating temperatures. It is equally important that all other factors such as grade and condition of oil, bearing clearances, and security of line connections be satisfactory before any adjustment is attempted. Tightening the pressure regulator is not proper compensation for diluted or broken-down lubricating oil.

c. Removal, Cleaning, and Inspection.

- (1) Remove plug (14, fig. 1), adjusting screw (12), spring (11), and ball (10).
- (2) Clean all parts in SD and dry with compressed air.
- (3) Inspect ball seat and ball for score marks. True up seat when necessary.
- (4) Inspect spring for wear, distortion, cracks, and weakness.
- (5) Inspect adjusting screw for damage to threads.
- (6) Replace all defective parts as authorized.
- (7) Replace the copper washer (13) to ensure an oil tight seal.

d. Regulator Adjustment.

- (1) Allow engine to run until oil reaches normal operating temperature.
- (2) Remove plug (4) from adjusting screw (12).
- (3) Check oil pressure at oil pressure gauge on instrument panel.
 - (a) Recommended Pressure (Hot-Idle) —5 to 10 lbs.
 - (b) Recommended Pressure (Hot-Full Throttle)—15 to 25 lbs.
- (4) To increase the oil pressure, screw in the adjusting screw until recommended pressure is obtained.
- (5) To decrease the oil pressure, screw the adjusting screw out until recommended pressure is obtained.
- (6) After adjustment is completed, replace the protection plug.

21. Engine Mounts

a. Description. The rear engine mount is a rubber insert in the pump mounting bracket (13, fig. 8) attached to the timing gear housing. The two front engine mounts are rubber inserts (12, fig. 9) at the mounting flanges of the flywheel housing (5).

b. Removal.

- (1) Remove locknuts (33, fig. 8) (14, fig. 9).
- (2) Remove capscrews (29, fig. 8) (11, fig. 9), washers (31, 32, fig. 8) (13, fig. 9), and nuts (33, fig. 8) (14, fig. 9).
- (3) Raise engine with suitable sling.
- (4) Remove rubber engine mounts.

c. Inspection and Cleaning.

- (1) Clean rubber mounts with approved solvent.
- (2) Inspect rubber for cracks, deformation, and other wear or damage.
- (3) Inspect metal capscrews, locknuts, and washers, for damage.
- (4) Replace damaged parts as authorized.

d. Installation. Install in reverse order of removal.

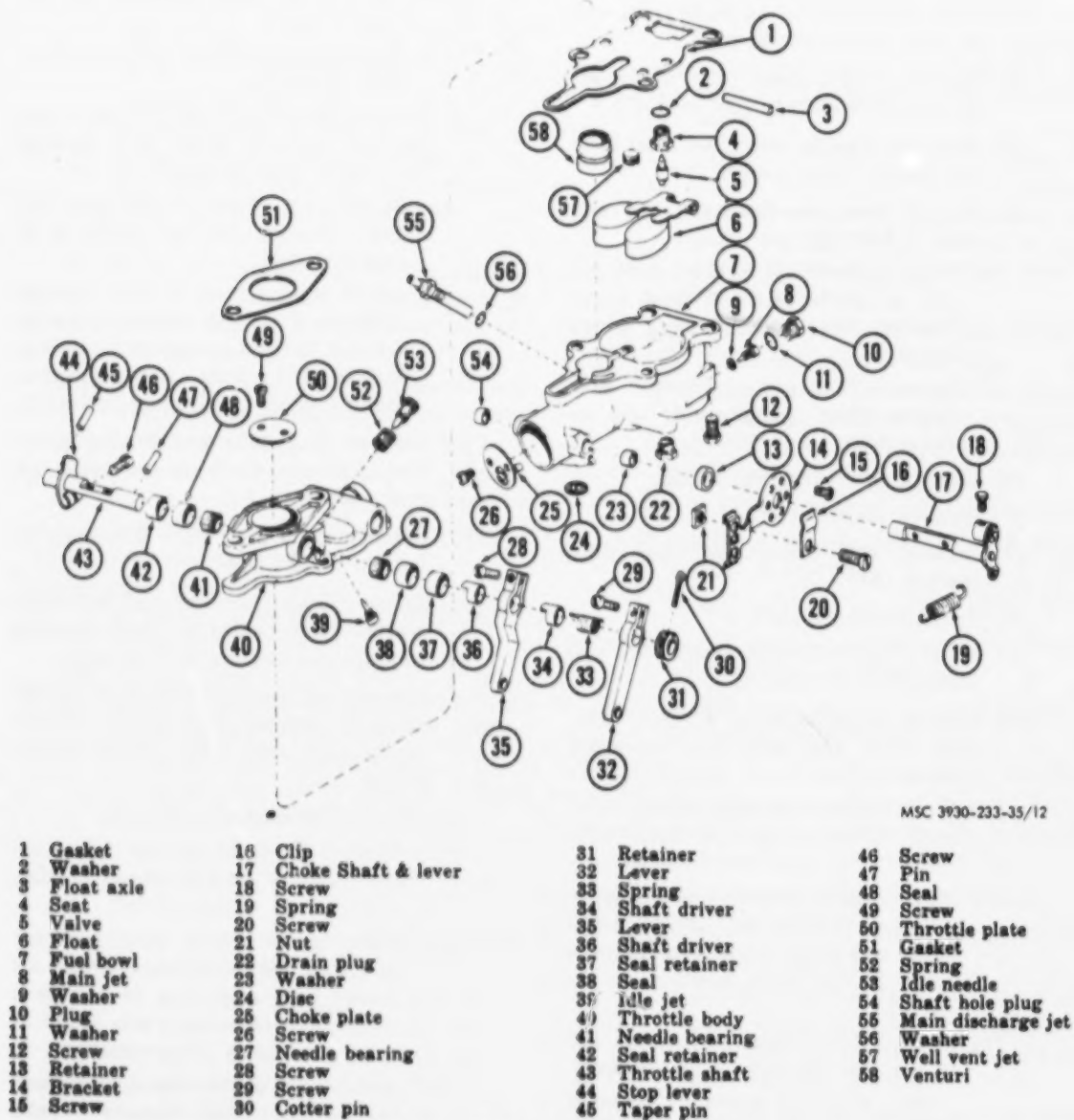
Section III. FUEL SYSTEM

22. Carburetor

a. *Description.* The carburetor used in this fuel system is a single venturi, updraft type with fixed jets covering all speeds except idle. The flow of fuel through the main jet system is

controlled by the size of the jet. The idle adjusting screw controls the fuel mixture for the idle system.

It has an air-bleed well method of compensation, an idle fuel adjusting screw, and an idle



MSC 3930-233-35/12

Figure 13. Carburetor, exploded view.

throttle stop screw. The air intake of the carburetor is provided with a choke valve.

b. Removal and Installation. Refer to TM 10-3930-233-20).

c. Disassembly.

Note. Before disassembling carburetor, clean unit with solvent and dry with compressed air. Refer to Fig. 13 and follow disassembly procedure as outlined below.

- (1) Remove two mounting studs from carburetor body (40, fig. 13).
- (2) Remove four screws (12) which attach throttle body to fuel bowl (7).
- (3) Separate throttle body from fuel bowl and discard bowl gasket (1).
- (4) Remove float mounting pin (3) and remove float (6).
 - (a) Press screwdriver against float pin (3) at slotted side of float hinge bracket and force through hinge bracket.
 - (b) Remove float pin completely with fingers from opposite side and remove float.
- (5) Remove fuel valve (8) needle.
- (6) Remove venturi (58).
- (7) Remove fuel valve seat and fibre washer (9).
- (8) Remove idle jet (39).
- (9) Remove idle adjusting needle (53) and friction spring (52).
- (10) Remove throttle plate screws (49), shaft (43) and stop lever assembly (44) as follows:
 - (a) Unscrew throttle stop screw (46) until threaded end is flush with lever.
 - (b) Make match marks with center punch on throttle body and all levers to act as a guide to reassemble these parts in the same position as removed.
 - (c) File off the riveted or peened end of the throttle plate (49) screws.

Note. When such screws are riveted or peened the threaded end of the two screws must be filed flat before removal to avoid

breakage or stripping of threads in the shaft. In some cases it may be necessary to use a small ($\frac{1}{4}$ ") round file and cut slightly below the surface of the shaft because of a slight counterbore around the screw hole.

Caution: Avoid striking and cutting the side of the throttle body bore or the throttle plate when filing the screws.

- (d) Remove the screws and pull out the throttle plate.
- (e) Remove the throttle shaft and stop lever assembly.
- (11) Remove the throttle shaft packing and packing retainer from the throttle body shaft holes as follows:
 - (a) Screw a ($\frac{5}{16}$ ") fine thread taper tap into bushing retainer until it is firmly seated.
 - (b) Insert long punch or rod through opposite shaft hole and drive punch against the end of tap until retainer is free of the body. Repeat operation for other bushing and retainer.
- (12) Remove plug (10) and washer from fuel bowl and then remove main jet and washer (8, 9).
- (13) Remove drain plug (22) from outside bottom of fuel bowl.
- (14) Remove drain discharge jet and fibre washer from center of large opening in machined surface of fuel bowl.
- (15) Remove well vent jet (55) from center of large opening in machined surface of the fuel bowl with a small screwdriver.
- (16) Disassemble choke as follows:
 - (a) Remove the lever spring (19) from the choke lever and choke bracket (14).
 - (b) Make match marks with a center punch or file on choke bracket, air intake bore and lever to act as a guide to reassemble these parts in same position as when removed.
 - (c) Remove the choke bracket screw and lockwasher, and remove choke bracket.

- (d) Remove the shaft hole plug (54).
- (e) Remove the choke plate screws (26) and remove the choke shaft (17) and choke plate (25).

(17) Press out choke shaft bushings and retainer.

d. Cleaning and Inspection.

- (1) Clean all parts thoroughly and dry with compressed air. Blow out all passages in the air intake and fuel bowl casting. Be sure all carbon deposits have been removed from the throttle bore and idle discharge holes. It is advisable to reverse the flow of compressed air in all passages to insure that all dirt has been removed. Never use a wire or drill to clean out jets.
- (2) *Float Assembly.* Inspect top side of float lever for wear where it contacts fuel valve needle. Such wear can affect the float level.
- (3) *Float Mounting Pin.* Replace if any wear can be visually detected on the bearing surface.
- (4) *Fuel Valve Seat And Needle.* Always replace valve seat and needle because both parts wear and may cause incorrect float level.
- (5) *Idle Adjusting Needle.* Inspect point of needle. Must be smooth and free of ridges or score marks.
- (6) *Throttle And Choke Plates.* Inspect plate for burrs or damaged edges. Never clean plates with a buffing wheel or a sharp instrument.
- (7) *Throttle And Choke Shafts.* Check bearing surfaces for wear.
- (8) *Gaskets.* Replace all gaskets and fibre washers any time the carburetor is disassembled.
- (9) *Check Specifications.* Check correctness of following jet sizes:

Idle Jet	-----	No. 11
Fuel Valve	-----	No. 35
Main Jet	-----	No. 19
Discharge Jet	-----	No. 50
Well Vent Jet	-----	No. 23
Venturi	-----	No. 16

- (10) Replace only those parts available in the carburetor repair kit. Damage to any other parts will require replacement of the entire carburetor assembly.

e. Reassembly.

Note. Before assembling carburetor make certain that all inspections and checks have been completed. Refer to Figure 12 for correct location of parts.

- (1) Install choke assembly as follows:
 - (a) Press choke shaft bushings and retainer into bores until retainer is flush with machined surface of fuel bowl.
 - (b) Insert choke shaft into air intake.
 - (c) Insert choke plate into air intake making certain plate is located in same position in the intake in regards to the poppet valve as when removed.
 - (d) Install choke plate retaining screws.
 - (e) Install choke shaft hole plug.
 - (f) Using match marks made at disassembly, place choke bracket on boss of air intake and secure with screws and lockwashers.
 - (g) Install choke shaft lever and spring.
- (2) Install main discharge jet and fibre washer in fuel bowl.
- (3) Install well vent jet in fuel bowl.
- (4) Install main jet and fibre washer along with washer and plug.
- (5) Install drain plug in threaded passage in bottom of fuel bowl.
- (6) Install throttle shaft bushings and retainers in both sides of throttle body. Retainers to be flush so as to avoid striking throttle lever.
- (7) Install throttle assembly as follows:
 - (a) Insert throttle shaft and lever in throttle body.
 - (b) Rotate the throttle shaft to wide open position, insert throttle plate and then rotate to closed position holding plate in place.
 - (c) Install throttle plate screws and tighten securely, making certain

plate is correctly centered in body bore.

Note. The screw holes in the throttle plate are off center. Start the side of the throttle plate with the shortest distance between the screw holes and beveled edge into the shaft first. The throttle plate is made with two opposite edges beveled to fit the throttle body bore when the plate is closed. The throttle plate will not close tightly if installed upside down. To properly center the plate in the bore, the screws should be started in the shaft and then with the plate closed, and pressure maintained with the fingers, tighten the screws. When correctly installed, the side of the plate farthest away from the mounting flange will be aligned with the idle discharge holes when the plate is closed.

- (8) Install idle adjusting needle and friction spring. Seat lightly and then back out $1\frac{1}{4}$ turns.
- (9) *Install idle jet.*
- (10) *Install fuel valve seat and fibre washer.* Install fuel valve needle, followed by float and mounting pin.
- (11) *Set float level.* Should be $1\frac{5}{32}'' \pm \frac{3}{64}''$ from top of float to machined surface of throttle body. If necessary, bend float lever close to float body with long nosed pliers to obtain correct level.
- (12) Insert venturi in throttle body bore, large opening first. Make sure venturi flange is set in throttle body recess below the bowl gasket.
- (13) Assemble the two completed bodies, with gasket, and tighten the four screws evenly and firmly.
- (14) Hold throttle lever in closed position and turn stop screw until it contacts stop on body; then turn screw in $1\frac{1}{2}$ additional turns.

f. Installation.

- (1) Place a new gasket over mounting studs of carburetor flange, mount carburetor and secure with nuts and lock-washers.
- (2) Install fuel line on carburetor and tighten securely to eliminate any leaks.

- (3) Connect throttle linkage, choke control and air cleaner.

- (4) Start engine and run until operating temperature is reached; then make conventional carburetor adjustments.

23. Governor

a. Description. The governor is of the conventional centrifugally actuated weight type. It is mounted on the left side of the engine and is driven directly from the timing gear train. The governor shaft runs in ball bearings at each end of the cast iron housing. The weight carrier is retained on the shaft by a press fit and a taper pin. The action of the weights against the governor sleeve is transmitted through a ball thrust bearing to the governor shifter, thence to the external governor lever. The lever actuates a control rod which changes the position of a butterfly valve located in the carburetor. If the engine slows down, the governor weights close, opening the butterfly valve to give additional fuel to the engine. As the engine speeds up, the weights open forcing the thrust bearing out against the shifter and the lever, actuating the control rod, and closing the butterfly valve.

The action of the governor weight is opposed and balanced by the external governor spring which may be adjusted to give the desired high idle speed. Governor springs are carefully calibrated and should only be replaced with the correct replacement spring. An adjusting screw is provided in the governor housing cover for use where an engine surge condition might be encountered at high governed R.P.M.

The specifications of the governor are determined to give control of engine speed as specified by the manufacturer. The governor is set at the factory to hold no load engine speed to 2200 R.P.M.

New or overhauled units, sometimes will not come up to specified governor speed until it has been run in enough to reduce friction and develop maximum efficiency. Governor adjustments that are changed to meet this condition will have to be reset after the unit has been run in.

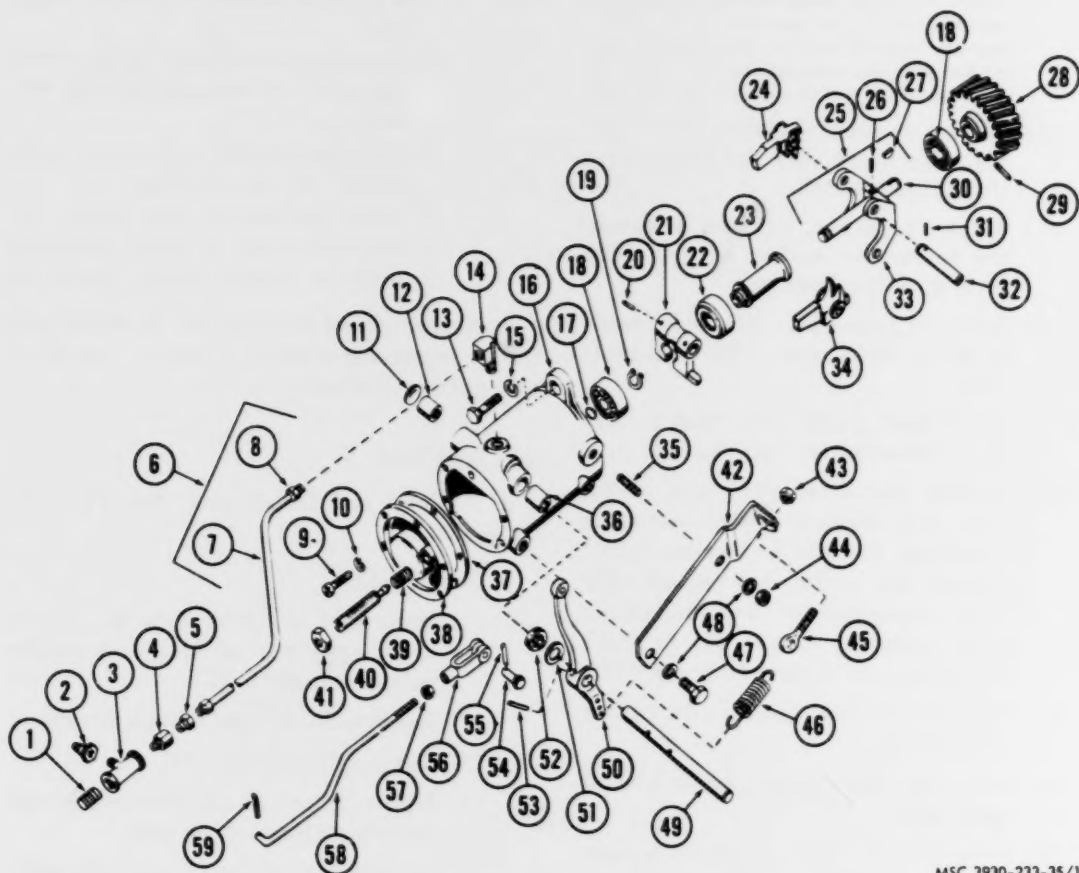
Note. As the life of any machine falls off rapidly when it is speeded up beyond safe limits, the governor should be kept in operation at all times to protect the engine against damage and abuse.

b. Removal and Disassembly. (fig. 14)

- (1) Remove control rod from governor lever (58) by removing the cotter pin (55) and clevis pin (54). Do not dis-

turb the length of the control rod.

- (2) Remove lubricating oil line (6) from top of governor housing.
- (3) Remove the two capscrews (13) and lockwashers (15) which mount the governor to the gear train housing. Governor can now be removed from the engine.



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- | | | | |
|----------------------|----------------------|---------------------------|---------------------|
| 1 Nipple | 16 Governor housing | 31 Roll pin | 46 Governor spring |
| 2 Bushing | 17 Preformed packing | 32 Weight shaft | 47 Capscrew |
| 3 Tee | 18 Ball bearing | 33 Weight carrier | 48 Lockwasher |
| 4 Restrictor fitting | 19 Snap ring | 34 Weight | 49 Lever shaft |
| 5 Male fitting | 20 Roll pin | 35 Stud | 50 Lever |
| 6 Governor oil line | 21 Shifter lever | 36 Roller bearing | 51 Washer |
| 7 Copper tube | 22 Thrust bearing | 37 Gasket | 52 Oil seal |
| 8 Nut | 23 Governor shifter | 38 Governor housing cover | 53 Roll pin |
| 9 Machine screw | 24 Weight | 39 Bumper spring | 54 Rod clevis pin |
| 10 Lockwasher | 25 Shaft assembly | 40 Screw | 55 Pin |
| 11 Expansion plug | 26 Roll pin | 41 Nut | 56 Rod end (clevis) |
| 12 Roller bearing | 27 Woodruff key | 42 Bracket | 57 Jam nut |
| 13 Capscrew | 28 Governor gear | 43 Adjusting nut | 58 Governor rod |
| 14 Elbow | 29 Roll pin | 44 Hex nut | 59 Cotter key |
| 15 Lockwasher | 30 Shaft | 45 Adjusting screw | 60 Bearing |

Figure 14. Governor.

- (4) After removing the governor assembly from the engine, it should be washed in clean solvent and dried with compressed air.
- (5) Note the location of the tension spring (46) in the shifter lever and note the position of the adjusting nut (43) on the tension adjusting screw (45).
Note. Whenever the governor is dismantled, carefully mark the governor parts before they are removed so that they will be reassembled with the same adjustment and in the same places from which they were removed.
- (6) Remove tension adjusting nut (43), adjusting screw (45) and spring from the spring bracket.
- (7) Remove capscrew, nut and lockwashers to remove spring bracket (42) from governor housing.
- (8) Drive out groove pin (29) which holds governor drive gear (28) on shaft (30).
- (9) Install gear puller and remove drive gear. Remove key from shaft.
- (10) Remove end cover (38) and gasket (37) from housing by first removing capscrews (9) and lockwasher (10). Discard the gasket and replace with new. Loosen locknut (41) and remove surge adjusting screw (40) to check for broken or damaged spring (39).
- (11) Remove governor weights (24, 34) as an assembly.
- (12) Drive pin (53) from governor control lever (50).
- (13) Using a drift, drive pins from weight shifter fork (25).
- (14) Drive out shifter lever shaft (49). While removing shaft plug (11) will be driven out opposite side of housing (16).
- (15) After shaft and lever (50) are removed, oil seal (52) and needle bearing (36) can be removed from housing. Replace oil seal.
- (16) Remove groove pin (31) from shaft (32) to remove governor weights.

c. Cleaning and Inspection.

- (a) Wash all parts in SD and dry with compressed air.
- (b) Inspection.
 1. Inspect governor weights (24, 34) and weight carrier (33) for excessive wear or looseness.
 2. Check shaft bearings for evidences of sticking excessive wear or roughness.
 3. Inspect governor housing for cracks and worn or damaged bearing surfaces.
 4. Check lubricating oil line for kinks, cracks, dirt or blocking.
 5. Check springs for wear, cracks, deformation rust, or other conditions likely to impair correct operation.

d. Assembly and Installation. Assemble and install in reverse order of *b* above. Install all new gaskets and seals.

24. Fuel Tank

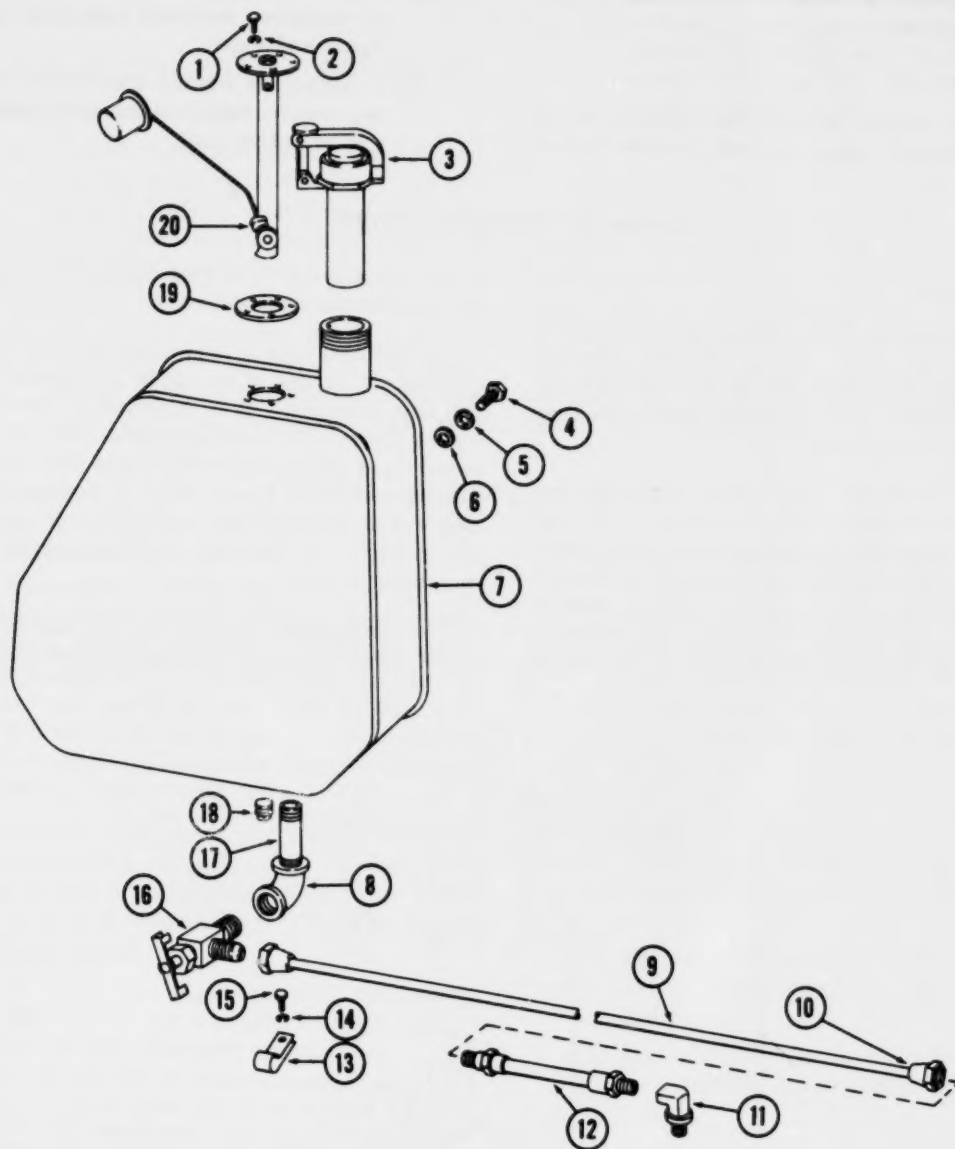
a. Removal and Installation. See (TM 10-3930-233-20).

b. Disassembly.

- (1) Open shut off valve (16, fig. 14) to drain any residual fuel, and remove valve from elbow (8).
- (2) Remove elbow from bottom of tank.
- (3) Remove drain plug (18).
- (4) Remove filler cap (3) assembly by unscrewing from top of tank.
- (5) Remove five screws (1) and lockwashers which mount fuel gauge sending unit (20) in fuel tank, and carefully lift unit out of tank. Be careful not to bend the float arm during removal or installation.

c. Cleaning and Inspection.

- (1) Flush tank with solvent and dry with compressed air.
- (2) Inspect tank for rust, cracked seams or damaged threads.



MSC 3930-233-35/14

- | | |
|-----------------|-----------------|
| 1 Hex screw | 11 Elbow |
| 2 Lockwasher | 12 Hose |
| 3 Filler cap | 13 Clamp |
| 4 Hex screw | 14 Lockwasher |
| 5 Lockwasher | 15 Screw |
| 6 Flat washer | 16 Needle valve |
| 7 Fuel tank | 17 Nipple |
| 8 Elbow | 18 Drain plug |
| 9 Tube assembly | 19 Gasket |
| 10 Union | 20 Sender |

Figure 15. Fuel tank and lines.

- (3) Inspect accessories for damage or corrosion.

d. Repair.

- (1) If damage is such that welding can be used to repair the tank, be sure to flush

tank thoroughly to remove all traces of explosive solvents and fuel, both liquid and vapor.

- (2) If damage is beyond reasonable welding repair, replace tank and accessories as authorized.

Section IV. COOLING SYSTEM

25. Radiator

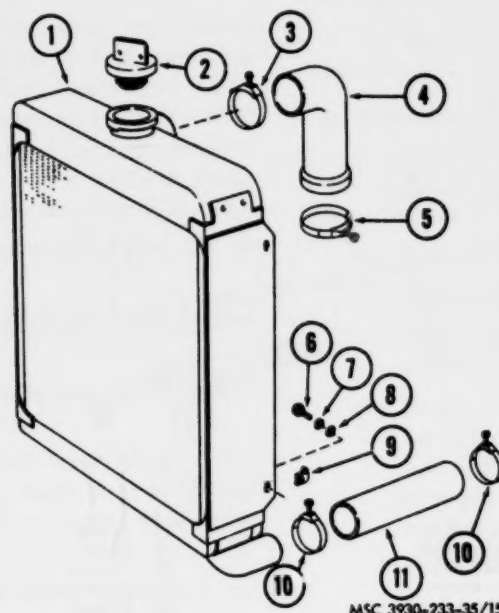
a. Description. The engine cooling system consists of the water pump, radiator, thermostat, cooling fan, water passages in the cylinder block and head, and necessary hoses and lines to complete the system.

The water pump draws water from the bottom of the radiator and circulates it through the water passages in the engine. It then passes from the cylinder head of the engine, through the thermostat and the upper radiator hose, to the upper part of the radiator. The water is cooled as it passes from the top to the bottom

of the radiator by air drawn through the radiator core by the cooling fan.

The radiator core is of the conventional tubular type consisting of an upper and lower tank and side members. It is mounted to the truck frame inside the counterweight and is protected by a grille mounted in the back of the counterweight. A Power Shift transmission oil cooler is an integral part of the bottom tank of the radiator to prevent overheating of the transmission oil.

The thermostat, located at the top of the water pump housing, operates automatically to



- | | | |
|--------------------|--------------------|---------------------|
| 1 Radiator | 5 Upper hose clamp | 9 Spacer |
| 2 Pressure cap | 6 Capscrew | 10 Lower hose clamp |
| 3 Upper hose clamp | 7 Lockwasher | 11 Lower hose |
| 4 Upper hose | 8 Flat washer | |

Figure 16. Radiator and connections.

maintain a normal operating temperature of approximately 165°.

b. *Removal.* Refer to (TM 10-3930-233-20).

c. *Inspection and Repair.*

- (1) Clean the air passages in the core and test for clogging and leaks. Clean the core if clogging is evident and repair any leaks by soldering. Straighten any bent cooling fins.
- (2) The oil cooler requires as much attention as the radiator, if not more, to make sure transmission oil is maintained at correct operating temperature. Blow out the cooler with com-

pressed air. If cooler restriction is evident, a small quantity of a cleaning solvent can be poured into one of the cooler openings and then blow out with compressed air.

- (3) If the oil cooler leaks, the radiator assembly will have to be replaced.

d. *Installation of Radiator.* To install the radiator, reverse the removal procedure. Be sure spacers are used to fill up any space between radiator and mounting bars. Make sure oil cooler connections are tight and that coolant hose connections are secure. Close the drain cock and fill the cooling system. Operate the engine and check for leaks.

Section V. ELECTRICAL SYSTEM

26. Generator

a. *Description.* The generator is a 12 volt, two brush, shunt wound unit controlled externally by a voltage regulator. Generator armature is supported by a bronze bushing at commutator end and a ball bearing at pulley end. Unit is cooled by a fan integral with the pulley, keyed on armature shaft at pulley end. Brushes are held by reaction type holders.

Generator is hinged from bracket attached to cylinder block and driven by "V" belt from pulley on end of crankshaft. Generator armature revolves at approximately 2 times engine crankshaft speed.

As a continuous high charging rate would soon destroy battery, a current-voltage regulator is wired into generator circuit.

Note. The best way to obtain maximum service from generators with minimum trouble is to follow a regular inspection and maintenance procedure. Periodic lubrication, inspection of brushes and commutator, and checking of brush spring tension is essential to the inspection procedure. In addition, disassembly and thorough overhauling of generator at periodic intervals is desirable as a safeguard against failures from accumulation of dust and grease and normal wear of parts. This is particularly desirable on lift trucks where maintenance of operating schedules is of special importance.

b. *Removal.*

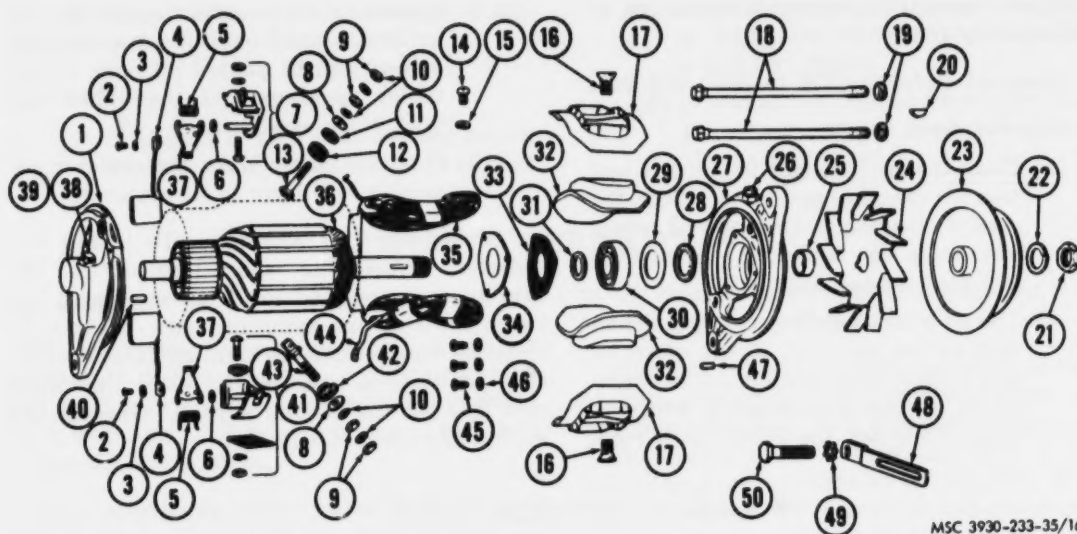
- (1) Disconnect armature and field leads from terminals (13, 43, fig. 17) on generator.

- (2) Remove capscrew, lockwasher and plain washer from adjusting brace.

- (3) Loosen the two capscrews which attach generator to mounting bracket, move generator towards engine and remove drive belt. Then remove capscrews and lift generator away from engine.

c. *Disassembly.* The disassembly procedure may vary from the following instructions. Disassembly should proceed only so far as is necessary to make repair or replacement of defective parts.

- (1) Secure generator in a bench vise, being careful not to distort field frame.
- (2) Remove the two through bolts (18) and remove commutator end frame (38).
- (3) Remove screw (2) and lockwasher (3) from brush leads and remove brushes (4) from brush holders (7, 41).
- (4) Remove drive end frame (27) along with armature (36) and pulley (23) from field frame.
- (5) Place armature in a vise with soft jaws and remove nut (21) and lockwasher (22), fan (24), pulley (23), key (20), spacer (25) and drive end frame (27).



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- | | | |
|-------------------------|-------------------------------|------------------------------|
| 1 Frame, Commutator End | 18 Thru bolt | 35 Field coil set |
| 2 Brush lead screw | 19 Lockwasher | 36 Armature |
| 3 Lockwasher | 20 Woodruff key | 37 Brush arm |
| 4 Brush | 21 Nut | 38 Oiler |
| 5 Brush spring | 22 Lockwasher | 39 Wick |
| 6 Brush arm washer | 23 Pulley | 40 Dowel pin |
| 7 Ground brush holder | 24 Fan | 41 Insulated brush holder |
| 8 Plain washer | 25 Space collar | 42 Bushing |
| 9 Nut | 26 Oiler | 43 Stud |
| 10 Lockwasher | 27 Frame, drive end | 44 Terminal clip |
| 11 Insulating washer | 28 Felt washer | 45 Screw |
| 12 Bushing | 29 Felt washer retainer plate | 46 Lockwasher |
| 13 Stud | 30 Ball bearing | 47 Dowel pin |
| 14 Screw | 31 Spacer washer | 48 Generator Adjusting Strap |
| 15 Lockwasher | 32 Pole shoe | 49 Lockwasher |
| 16 Screw | 33 Retainer gasket | 50 Capscrew |
| 17 Insulation | 34 Bearing retainer plate | |

Figure 17. Generator.

- (6) Disassemble drive end frame by removing bearing retainer plate (34), gasket (33), washer (31), and bearing (30). Felt seal (28) can be removed by removing seal retainer (29).

d. Inspection and Repair.

- (1) Wash all parts, except armature and field coils, with clean solvent and dry with compressed air.
- (2) Check drive end ball bearing (30) for roughness or scored races.
- (3) Inspect brush holders to make certain they are not bent or damaged so as to interfere with holding the brushes properly against commutator. Use a spring scale and check spring tension which should be 28 ounces.
- (4) Check fit of armature shaft in bushing in commutator end frame. Frame (38) should be replaced if excessively worn. Running clearance is 0.009"–0.013".
- (5) Carefully inspect commutator. If burned, rough or out-of-round, it must be cut down and the mica undercut.
 - (a) Place armature in a lathe and turn down commutator until true. Make sure cut is not made on commutator riser bars as solder will be removed, weakening coil connections at this section. Remain approximately $\frac{3}{16}$ " from riser bars.
 - (b) Undercut mica between bars to a depth not exceeding 0.030". Undercut must be full width of mica and

flat at bottom. After undercutting, clean out slots to remove any dirt and copper dust.

(c) Sand commutator lightly with No. 00 sandpaper to remove any burrs left from undercutting.

(d) Check armature on a growler for short circuits. Refer to 6a below.

(6) Check generator as follows:

(a) Check armature for shorts by placing it on a "growler," and with a steel strip or a hack saw blade held on armature core, rotate armature. If blade vibrates, armature is shorted in area of the core below the vibrating blade. Copper or brush dust in slots between commutator bars sometimes cause shorts which can be eliminated by cleaning out slots. Shorts at crossovers of coils at core end can often be eliminated by bending wire slightly and reinsulating exposed bare wire. If short cannot be eliminated generator must be replaced.

(b) To test armature for grounds, place one probe of test lamp on armature core or shaft and place other probe on each commutator bar in turn. If lamp lights, armature is grounded and generator must be replaced.

(c) Using test lamp, place one probe on field terminal on field frame and other probe on insulated brush lead. If lamp does not light, field coils are open and generator must be replaced.

(d) To test for grounded fields, place one probe of test lamp on field frame and other probe on field terminal. If lamp lights, field coils are grounded and generator must be replaced.

(e) To test whether ungrounded terminal or brush holder is grounded, place one probe of test lamp on terminal or brush holder, and other probe on field frame. If lamp lights, terminal or brush holder is grounded, and generator must be replaced.

e. Assembly.

(1) Assemble drive end frame (27):

(a) Install felt washer (28) and washer retainer (29).

(b) Repack bearing (30) with a high melting point ball-bearing grease and press into end frame. Install washer (31), gasket (33), and retainer (34) and secure to end frame.

(2) With armature in soft jawed vise, slide end frame onto armature shaft. Then install collar (25), key (20), and fan (24) and pulley (23). Install lockwasher (22) and nut (21). Tighten nut to 50-60 ft. lbs. of torque.

(3) With field frame assembly in a vise, place armature and drive end frame assembly in field frame aligning dowel pins with holes in end frame.

(4) Install new brushes, making sure that chamfered ends seat correctly on commutator. Make certain all connections are tight.

(5) Install commutator end frame (38), aligning dowel pins (40) with holes.

(6) Install and tighten the two generator thru-bolts (18).

f. Installation. Installation of generator on engine is a direct reversal of removal procedure. For polarization of generator, refer to (TM 10-3930-233-20).

27. Starter Motor

a. Description. Starter motor is a two field, four brush unit, with armature supported by three bushings one each at drive end, center and commutator end. The two brushes connected to field coil leads are insulated in commutator end frame and the two armature brushes are grounded. The starter motor is designed to operate under overload and produce high torque. Because of its size it can only be this for short periods of time, since in order to produce such power a high current must be used. High current creates considerable heat and if the starting operation is continued for

any length of time, the accumulated heat will cause serious damage.

Caution: Starter must never be used for more than 30 seconds at any one time. Allow starter motor to cool for 2 minutes before using again. Never use starter to move truck.

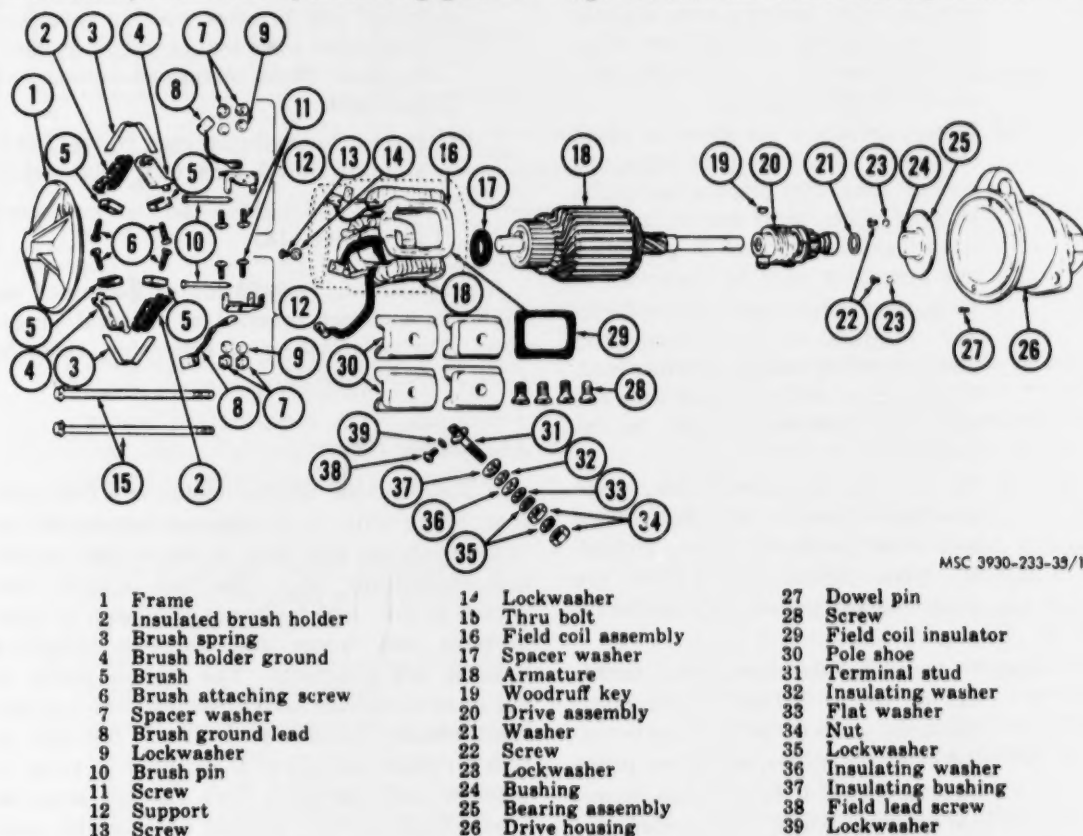
The drive mechanism is a "Folo-Thru" type drive. It incorporates a locking feature which prevents demeshing of drive pinion from flywheel ring gear, until a pre-determined flywheel speed is reached. Automatic meshing of drive pinion with flywheel ring gear is accomplished in usual manner. If engine fails to continue running, due to weak or irregular firing, premature demeshing of pinion from ring gear is prevented by a locking feature. Cranking is automatically resumed immediately after speed of overrunning parts of drive reaches that of starter motor armature shaft. When engine starts, centrifugal force will automatically demesh drive pinion from flywheel ring gear in

usual manner and drive will return to full demeshed position.

A magnetic solenoid switch is used in starter motor circuit as it uses less current, and allows use of a starting switch and lighter wires. When switch is turned to start position, coil in solenoid switch is energized causing a copper disc to engage two contacts making an electrical circuit to carry the high current flow directly between battery and starter motor.

Starter solenoid is mounted on the battery tray.

Note. The starter motor is a completely enclosed unit and requires very little maintenance. However, to ensure satisfactory operation, periodic inspections should be made to make sure mounting and wiring connections are tight and in good condition. Solenoid switch should be firmly mounted and all wiring connections should be clean and tight. These inspections should also include connections to battery and return circuit, as loose or dirty connections anywhere in the circuit will cause high resistance and reduced cranking efficiency. When



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Figure 18. Cranking motor.

mounting and wiring connections are kept in good condition, and motor responds instantly and cranks engine when switch is closed, motor may be considered to be in a satisfactory condition and disassembly is unnecessary.

Starter motor is equipped with graphite and oil impregnated bushings which should be lubricated only when motor is disassembled.

b. Removal. The motor is completely enclosed, and must be removed from engine every time service is necessary. Refer to (TM 10-3930-233-20), for removal.

c. Disassembly. Disassembly should proceed only so far as is necessary to make repair or replacement of defective parts.

- (1) Secure starter motor in bench vise at drive end of unit. Be careful not to damage drive end housing.
- (2) Remove the two thru-bolts (15, fig. 18) and slide commutator end frame (1) and field frame from armature.
- (3) Disconnect field lead from brush holder (2) and remove commutator end frame from field frame.
- (4) Brushes, brush holders and springs can now be removed from commutator end frame.
- (5) Remove capscrews (22) which mount center bushing (24) on drive end housing (26) and remove housing from armature shaft.
- (6) Drive mechanism (20) is keyed onto armature shaft and is removed by pressing off or using a puller.

d. Inspecting and Repairing.

- (1) Clean starter motor parts with approved solvents; but do not use cleaning solvents on drive mechanism, armature and field coils. Dry parts with compressed air.
- (2) Check bushings for roughness, scoring or excessive clearance. Bushing running clearances are as follows: commutator end frame 0.009"-0.0013", center bushing and drive housing bushing 0.0015"-0.005"
- (3) Check brush holders to be sure they will properly hold brushes against

commutator. Check spring tension, which should be 35 ounces. Check condition of brushes; if pitted or worn, replace.

- (4) Carefully inspect armature commutator. If burned, rough or out-of-round, turn down.
 - (a) Place armature in lathe and turn down commutator until true. Make certain cut is not made on commutator riser bars as solder will be removed, thus weakening coil connections at this section. Remain approximately $\frac{3}{16}$ " from riser bars.
 - (b) Check armature on a growler for shorts. Refer to (5) (a) below.
- (5) If test equipment is available, check starter motor as follows:
 - (a) Check armature for shorts by placing it on a "growler." Refer to Paragraph 26d.
 - (b) Test armature for grounds. Refer to Paragraph 26d.
 - (c) Using a test lamp, place probes on each of the field leads of starter motor. If lamp does not light, coils are open and starting motor must be replaced.
 - (d) Place one probe of test lamp on field frame and other probe on a field coil lead. If test lamp lights, starter motor terminal or one of field coils forming a pair are grounded, and starting motor must be replaced.
 - (e) Using test lamp, place probe on each of insulated brush holders in turn and other lead on commutator end frame. If lamp lights, brush holder is grounded due to defective insulation.

e. Assembly.

- (1) Secure cranking motor in bench vise and slide armature (18) into field coil housing.
- (2) Install brush holders (2) brushes (5) on commutator end frame (1). Place end frame on field frame and connect ungrounded brush leads to field coil terminals.

- (3) Install bearing assembly (25) on armature shaft (18) with long side towards commutator end of armature.
- (4) Install key (19) in armature shaft and press on drive mechanism. Apply thin coating of grease before pressing on drive assembly.

Note. If drive assembly is rotated to a fully extended lock position on screw shaft during replacement or during overhaul of cranking motor, do not attempt to force it in the reverse direction. Proceed to install drive even though it is fully extended. After starter motor is installed on engine and the engine starts, centrifugal force will demesh drive pinion from flywheel ring gear in the usual manner.

- (5) Place drive end housing (26) on armature shaft after placing a few drops of oil on bushing (24). Then fasten center bearing on drive housing.
- (6) Place spacer (17) on commutator end of armature shaft and install armature complete with drive housing in field frame assembly. While installing

armature, pull commutator end frame away from field frame and make certain brushes are seated correctly on commutator.

Note. Install starter solenoid if unit has been removed from field frame.

- (7) Replace end frame and position drive end housing on field frame. Make certain both commutator end frame and drive housing are correctly positioned on field frame dowels. Then insert the thru-bolts and tighten securely.

f. Installation.

- (1) Insert drive end of starter motor in flywheel housing. If drive mechanism is fully extended, mesh pinion gear with flywheel ring gear. Install mounting bolts and tighten securely.
- (2) Connect all electrical leads to either starter motor or starter solenoid.
- (3) Install side panel and lower the operator's seat.

Section VI. TRANSMISSION ASSEMBLY

28. Transmission Assembly

a. Description.

(1) General.

- (a) The Power Shift Torque Converter Drive consists of three major components—a torque converter, a hydraulically actuated clutch pack and a single speed constant mesh transmission.
- (b) Power from the engine is delivered to the torque converter which in turn drives a pump and a clutch pack. Housed in the clutch drum are two double faced clutch plates which, when activated move the truck forward or reverse through splined hubs transmitting power to the gear train.
- (c) If the reverse clutch is activated, power is delivered to the transmission through a hollow shaft which connects the reverse gear and reverse clutch. If the forward clutch

is actuated, power is delivered to the transmission through a solid shaft, which rotates inside the hollow reverse shaft, connecting the forward gear and forward clutch.

(2) Transmission hydraulic system.

- (a) The hydraulic system consists of the torque converter, a pump driven by the converter, control valve and a clutch pack.
- (b) The control valve is mounted on the transmission housing and forms the top closure of the gear case. Machined porting plates are attached to the bottom of the valve to eliminate external piping. Passages in the plates align with passages drilled or cast into the transmission housing.
- (c) The clutch pack consists of a drum, a forward and a reverse clutch, pistons and cylinders. Clutches are engaged by oil pressure applied be-

hind the clutch pistons which causes engagement within the drum.

- (d) The gear type oil pump provides hydraulic pressure for the converter and the clutch pack. It is directly driven from the input side of the converter. Since the converter is mounted on the engine flywheel, the pump is in operation whenever the engine is running. This means that there is hydraulic pressure even with the engine idling.
- (e) With the converter pump operating, the oil is taken from the sump and pumped under a pressure of between 100 P.S.I. and 150 P.S.I., to the converter and to the pressure regulator of the control valve.

b. Pressure Tests.

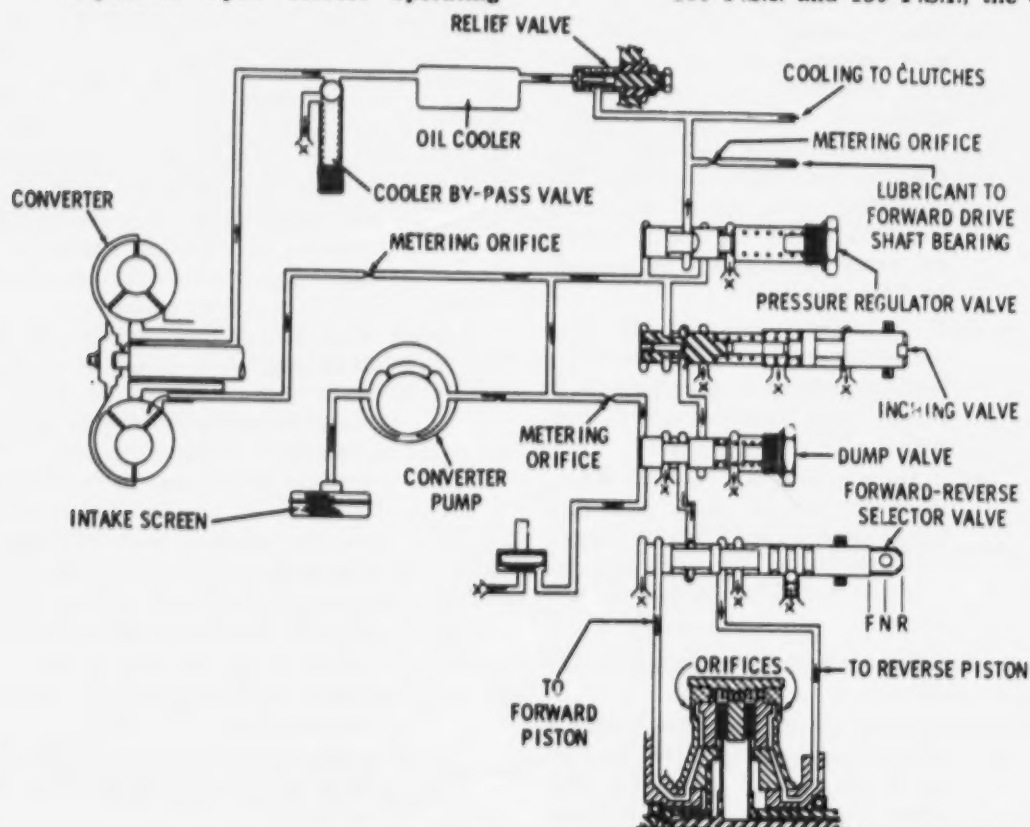
- (1) General. Since the "Power Shift" is dependent upon correct operating

pressures for efficient operation, if in doubt, the pressure should be checked for the following: pump pressure, converter pressure, clutch pack pressure and clutch cooling oil pressure. Oil temperature should be 80° to 100°F., when checking pressures.

(2) Pump pressure.

- (a) To check PUMP pressure, install a pressure gauge calibrated 300 P.S.I., in the port marked "P" on the side of the transmission just forward of the inspection cover (6, fig. 9) on the flywheel cover. Leave the transmission in neutral and start the engine. Accelerate the engine to full governed speed and note the pressure indicated on the pressure gauge.

- (b) If the pump pressure is between 100 P.S.I. and 150 P.S.I., the con-



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Figure 19. Power shift—hydraulic schematic.

verter pump is in normal operating condition.

- (c) If the pump pressure is over 150 P.S.I., check the regulator valve spring and spool; check the cooler by-pass and check for restricted lines and passages. If the pump pressure is below 100 P.S.I., check for low oil level, a faulty pump, excessive line leakage, a faulty regulator valve or enlarged clutch cylinder orifices.

(3) *Torque converter pressure.*

- (a) To check CONVERTER pressure, install a pressure gauge calibrated to 100 P.S.I., in the port marked "C" on the side of the transmission just forward of and slightly above inspection cover (fig. 9) on the fly-wheel housing. Leave the transmission in neutral and start the engine. Accelerate the engine to full governed speed and note the pressure indicated on the pressure gauge.
- (b) If the converter pressure is 65 P.S.I. to 80 P.S.I. maximum, the converter is in normal operating condition. With the engine idling, converter pressure will be between 40 P.S.I. and 60 P.S.I.
- (c) If the pressure is above 80 P.S.I., check for cause of excessive pump pressure, enlarged metering orifice; or restricted converter return passages.
- (d) If the pressure is below 65 P.S.I., check for low oil level, restricted intake screen, faulty pump, clogged converter orifice in pump collector ring or a faulty cooler by-pass valve.

(4) *Forward and Reverse Pressure (at stall).*

- (a) To check clutch pressures, install a pressure gauge in the front port on top of the control valve (fig. 28). Check clutch pressure in forward and reverse direction by the following method. Position truck against

wall and apply both the parking brake and the foot brake—drive wheels must be locked. Accelerate engine momentarily to wide open throttle with the truck in a stalled condition. Note the pressure indicated on the pressure gauge.

- (b) If the reading is not below 65 P.S.I., or does not go above normal pump pressure, the pressure in the "forward" circuit is normal. Pressure should never be below 65 P.S.I.
- (c) If the pressure is above normal pump pressure, check for incorrect or faulty regulator valve spring (4) tension, inoperative inching valve (3) or a restricted orifice in the forward cylinder (4, fig. 29).
- (d) If the pressure is below 65 P.S.I., check for low oil level, restricted lines or passages, damaged collector rings, faulty or incorrectly adjusted selector valve (20, fig. 28) faulty pump (6, fig. 30) or excessive leaks in the drum assembly (13, fig. 29).
- (e) When the engine is idling with the clutch engaged, the reverse circuit pressure should be 25 P.S.I. Pressure setting may vary $\pm 2\frac{1}{2}$ P.S.I. This pressure setting is made at the adjustable pressure regulator in the line from the oil cooler.
- (f) The ball in the regulator (21, fig. 28) should never be seated when the truck is in operation. To check, remove the regulator with its line and with the engine running, note whether or not any flows from the opening. If not, the ball is seated and the regulator must be repaired. Under no circumstances should the transmission be run without oil circulating through the pressure regulator.

(5) *Forward and reverse clutch pressure (free running).*

- (a) Raise both drive wheels off floor and block securely with both wheels free to rotate.
- (b) Hold inching pedal up so inching valve plunger cannot move.

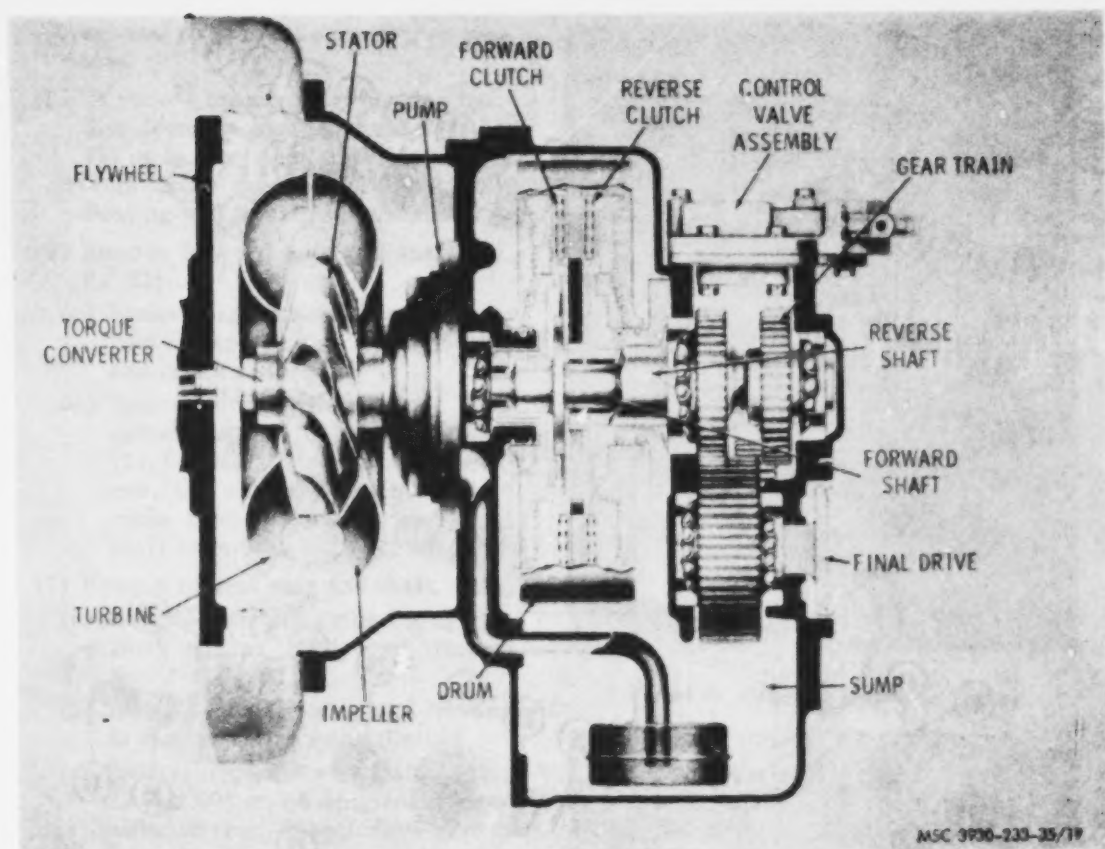


Figure 20. Power shift torque converter drive.

- (c) Run engine at full governed speed with shift lever in either forward or reverse position. Check pressure in both directions.

- (d) If pressure is abnormal check (4) above.

c. Removal.

- (1) Remove floor plates, seat deck assembly, battery case and battery, and one corner post (TM 10-3930-233-20).
- (2) Drain oil from transmission by removing drain plug at rear of sump (fig. 20).
- (3) Disconnect cooler lines at bottom and right side of sump (2, 8 fig. 35).
- (2) Remove all control linkage (TM 10-3930-233-20).

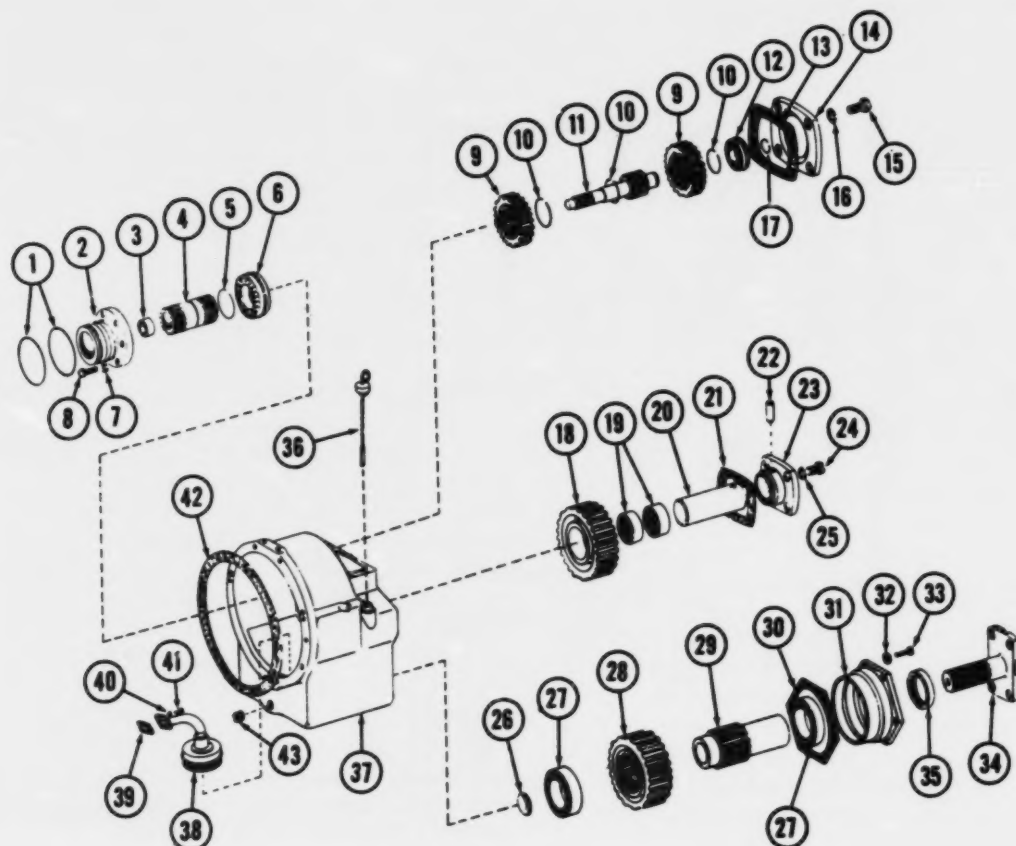
- (5) Disconnect universal joint at transmission (4, fig. 36).

- (6) Remove six capscrews and lockwashers which mount converter (5, fig. 30) to flywheel. Use suitable tool to rotate flywheel.

- (7) Attach lifting chain and chain hoist to transmission, and remove from truck.

d. Disassembly.

- (1) After transmission is removed from truck, place on suitable working area.
- (2) Remove capscrews (25, fig. 28) from valve block (1, fig. 28) and remove from transmission.
- (3) Slide converter (3, fig. 30) off turbine shaft (7, fig. 29). Mark pump and



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- | | | |
|------------------------|------------------------|------------------------|
| 1 Seal ring | 16 Lockwasher | 31 Shaft retainer |
| 2 Collector ring | 17 Snap ring | 32 Gasket |
| 3 Needle bearing | 18 Idler gear assembly | 33 Hex head bolt |
| 4 Reverse shaft | 19 Needle bearing | 34 Output flange |
| 5 Snap ring | 20 Idler shaft | 35 Oil seal |
| 6 Ball bearing | 21 Gasket | 36 Dip stick assembly |
| 7 Lockwasher | 22 Pin | 37 Transmission case |
| 8 Hex head bolt | 23 Retainer cap | 38 Oil screen assembly |
| 9 Low and Reverse gear | 24 Hex head bolt | 39 Gasket |
| 10 Snap ring | 25 Lockwasher | 40 Lockwasher |
| 11 Forward shaft | 26 Expansion plug | 41 Hex head bolt |
| 12 Ball bearing | 27 Ball bearing | 42 Gasket |
| 13 Gasket | 28 Countershaft gear | 43 Drain Plug |
| 14 Retainer | 29 Output shaft | |
| 15 Hex head bolt | 30 Gasket | |

Figure 21. Single speed transmission.

housing to insure proper installation and remove capscrews holding pump and collector ring (13) to converter housing. It may be necessary to tap pump assembly with rawhide hammer to free it from gasket.

(4) Lay transmission on gear case. Remove capscrews which mount converter housing (6) to gear case (14, fig. 21). Attach chain to housing and remove housing and disc drum assembly as a unit, taking care not to dam-

age seal rings in collector ring on gear case.

- (5) To remove the converter housing from disc drum, remove snap ring (1, fig. 29) on turbine shaft and slide housing from drum assembly (fig. 22, 23). Bearing will remain in housing.
- (6) Remove forward gear and shaft (11, fig. 21).
 - (a) Remove capscrews and lockwashers holding cap (14, fig. 21) to housing and remove cap.
 - (b) Remove inner snap ring from splined section of forward shaft (11, fig. 21). Using a rawhide hammer, tap shaft at clutch end and while holding forward gear, pull shaft from gear box (fig. 24).
- (7) Remove reverse gear and shaft.
 - (a) Remove inner snap ring (5, fig. 21) from splined section of reverse shaft (4, fig. 21).
 - (b) Identify collector ring and housing to insure proper reinstallation.
 - (c) Remove capscrews mounting ring (2, fig. 30) on housing and remove collector ring. If seal rings have to be replaced, unhook at ring opening and remove.
 - (d) Remove shaft while holding reverse gear in gear box (fig. 25).
 - (e) Bearings on both forward and reverse drive disc shafts can be removed by removing snap rings and pressing bearings from shafts.
- (8) Remove idler gear and shaft.
 - (a) Remove capscrews (25, fig. 21) holding idler shaft (20) and cap (23) to housing and remove cap and shaft. Note position of retaining pin (22) holding shaft in cap to insure proper reinstallation.
 - (b) Remove idler gear (fig. 26).
- (9) Remove output gear and shaft.
 - (a) Remove capscrews holding output shaft cap (33, fig. 21) to housing.
 - (b) Remove output shaft (29) and cap (31) while holding output gear in-



Figure 22. Removing housing and drum.



Figure 23. Removing clutch drum from converter housing.

side gear box (fig. 26). It may be necessary to tap the output shaft from inside the clutch housing to facilitate removal.

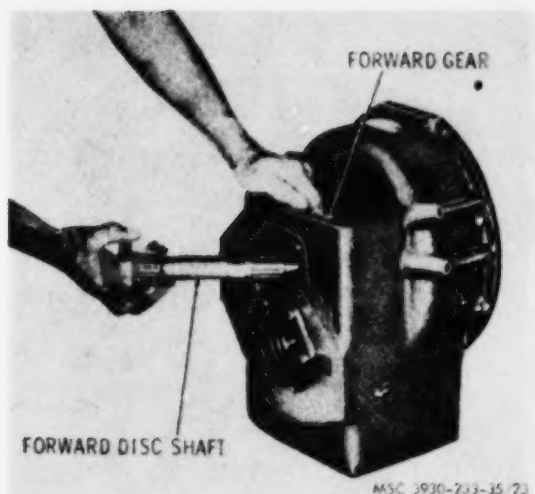


Figure 24. Removing forward gear and shaft.

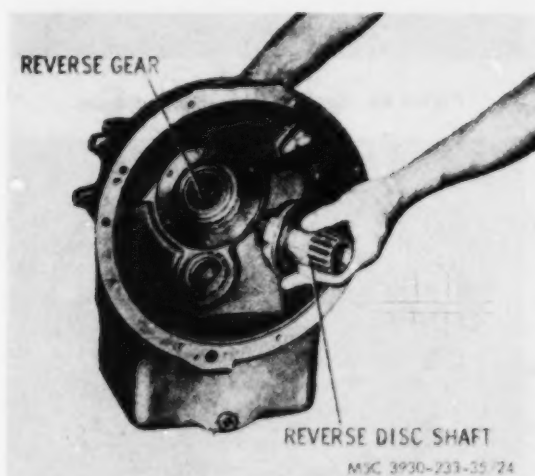


Figure 25. Removing reverse gear and shaft.

(c) Remove output gear (28, fig. 21).

(10) Remove sump strainer (38) by removing capscrews inside sump housing.

e. Cleaning and inspection.

- (1) Wash all parts in approved solvents.
- (2) Blow out passages in housings with compressed air.
- (3) Inspect bearings, seal rings, splined shafts, gears and hardware for wear and damage.

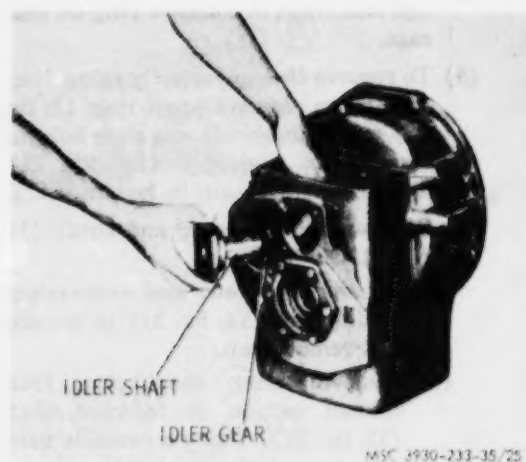


Figure 26. Removing idler gear and shaft.

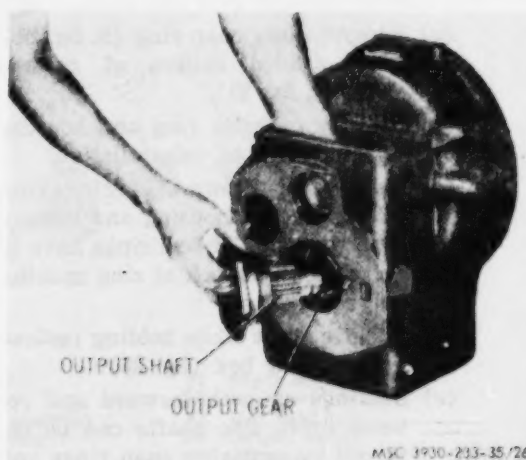


Figure 27. Removing output shaft and gear.

(4) Inspect sump screen for clogging or other damage.

(5) Replace all gaskets with new ones.

(6) Replace worn or damaged parts as authorized.

f. Reassembly.

(1) Reverse disassembly procedures with the following additional instructions.

(a) Make sure gasket (39, fig. 21) is in place when installing oil strainer in sump.

- (b) Make sure output shaft (29) is installed with internal splines to outside of gear case.
- (c) Make sure machined reliefs in idler shaft cap (23) are positioned down so that oil in cap will drain in housing.
- (d) As gears and bearings are being installed, coat with lubricant and make sure they rotate freely.
- (e) When installing collector ring (2) align match marks made in disassembly. Make sure rings rotate free on collector ring and that rings are properly hooked together at ring ends.
- (f) When installing forward and reverse drive disc shafts (11, 4) and gears (9) check to make sure snap rings holding gears on shafts are properly installed and seated.
- (g) Care should be exercised when installing converter housing (15, fig. 30) on turbine shaft (7, fig. 29) of disc drum (13) so that misalignment does not occur during assembly. Make sure snap ring holding converter housing to turbine shaft is properly seated.
- (h) When installing converter housing and disc drum (as a unit) into transmission housing, care should be exercised so as not to damage collector rings fitting into disc drum, as damage to these rings will cause the reverse piston and disc to be inoperative.
- (j) Use new gasket when replacing control valve.

g. Installation.

Note. For proper reinstallation of transmission and torque converter, refer to Paragraph 31. After correct alignment has been obtained, the following procedure is recommended:

- (1) Mark one mounting strap and flywheel for identification and remove converter from flywheel being careful not to damage or lose shims, if any, on converter pilot.

- (2) Position converter in pump at back of transmission, making sure converter hub tangs properly engage pump driven gear.
- (3) Reinstall transmission on flywheel bell housing and note following:
 - (a) Mount converter to flywheel by installing capscrews and lockwashers through timing mark inspection plate in flywheel bell housing.
 - (b) After converter has been securely installed, rotate until filler hole appears and add one quart of oil.
 - (c) After assembly has been installed in truck, add 10 quarts of oil to transmission.

Note. Oil should be changed every 500 operating hours (see LO 10-3930-233-20).

29. Control Valve

a. Description.

- (1) *Pressure Regulator Valve.* At the same time oil is being pumped to the converter and cooling circuit, it is also being delivered under full pump pressure to the pressure regulator valve in the control valve. The regulator controls the oil pressure delivered by the pump. The spring is calibrated to provide between 80 P.S.I., and 100 P.S.I., so that oil under controlled pressure is ready for delivery to the clutch pack. At the same time the regulator controls the amount of oil being delivered for clutch cooling. Also, a portion of the cooling oil is diverted for lubricating the front bearing of the forward drive shaft. Pressure is reduced by forcing the oil through a metering orifice.
- (2) *Inching valve.* From the regulator valve, oil passes to the inching valve. This valve is a variable regulator which permits the operator to vary pressure on the clutch plate from 80 P.S.I. maximum to 0 P.S.I. minimum. When an "inching" operation is performed, actuating the inching pedal relieves spring pressure on the inching valve spool. This action allows

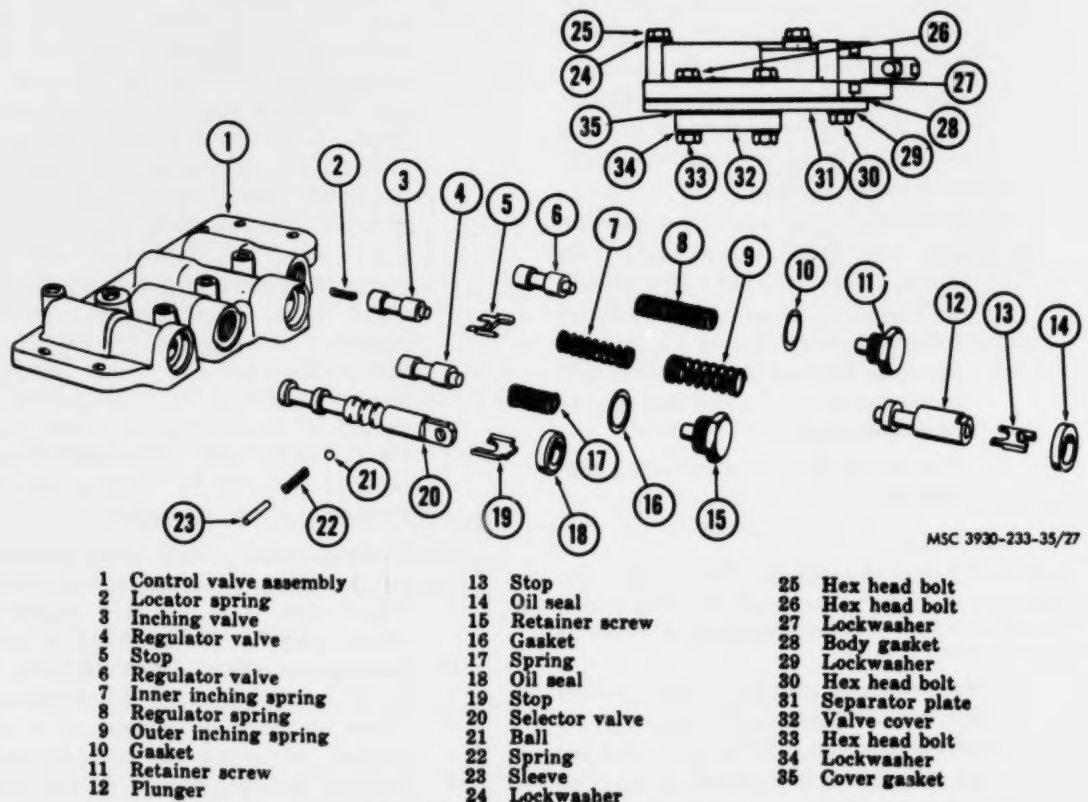
oil pressure in back of the spool to move it far enough to restrict the flow of oil to the selector valve, thus controlling pressure on the clutches. This allows a "feathering" effect during inching.

- (3) **Dump valve.** The forward and reverse clutch supply or dump valve is placed in the circuit to control the flow of oil to the selector valve. The valve spool is pressurized by the converter pump through a metering orifice in a branch circuit from the main supply line. Pump pressure at this orifice is reduced to 3 P.S.I., maximum with the engine at full governed speed.
- (4) **Selector valve.** Oil flowing through the dump valve, enters the selector valve. With the selector valve plunger in the neutral position, oil is blocked at this point and the truck will not

move. As soon as the directional lever is moved to either forward or reverse, the selector valve plunger opens the ports to either the forward or reverse clutch pistons. Movement of the piston, due to the oil pressure in the circuit, causes the clutch to engage the rotating clutch drum, thereby moving the truck. The orifices in the clutch drum cylinders are for the purpose of accelerating the release of pressure whenever the operating pressure to the clutches is blocked off or lowered.

b. Removal.

- (1) Remove the four bolts (25, fig. 28) and washers (24) holding control valve to transmission gear case.
- (2) Clean exterior of valve with approved solvent before proceeding with disassembly.



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Figure 28. Transmission control valve.

c. Disassembly

- (1) Remove cover (32) and gasket (35, fig. 28).
- (2) Remove two capscrews (30) at front of large plate (31) and remove plate and gasket (28).
- (3) Remove spring, detent ball and sleeve (22, 21, 23).
- (4) Remove forward-reverse selector valve plunger (20) after lock clip (19) has been removed from valve body (1).
- (5) Remove inching control plunger (12) by first removing lock clip (13) then seal (14) springs (7, 9) and spool (3) from control valve (1). Note small spring (2) in spool.
- (6) Remove cap (15) at regulator valve (6) and remove spring (17) and spool (4) from valve body.
- (7) Remove cap (11) at dump valve and remove spring (8) and spool (6) from valve body.

d. Cleaning and Inspection.

- (1) Clean all parts in approved solvents and dry with compressed air.
- (2) Blow out passages in valve body.
- (3) Check plungers and spools for score marks, and clean up crocus cloth if possible.
- (4) Check springs for damage.
- (5) Replace worn or damaged parts as authorized.
- (6) Replace oil seals, seal rings and gaskets.

e. Assembly.

- (1) Reverse disassembly procedures.
- (2) Make sure plungers and spools operate freely.
- (3) Make sure that locks at both forward-reverse selector valve and inching valve plungers are installed with angled edges facing back of valve body.

f. Installation.

- (1) Reverse removal procedures.

- (2) Torque capscrews to 5 to 10 foot pounds.

Caution: Do not exceed 10 foot pounds torque.

30. Drum and Disc Assembly

a. Description. The drum and disc assembly is comprised of a drum, forward and reverse discs, pistons and cylinders. Discs are engaged by oil pressure applied behind the disc pistons, which causes engagement with the drum. The unit operates in oil at all times for cooling and lubrication.

b. Removal. When it is determined that the drum and disc assembly has to be serviced it will be necessary to remove the transmission from the truck. Refer to paragraph 38.

c. Disassembly.

- (1) Place drum and disc assembly in arbor press. Apply pressure on turbine shaft (7, fig. 29) until cylinder (4) is depressed enough to remove large snap ring (2) from drum.
- (2) Slowly release pressure on press and remove cylinder (4) making sure it is kept in alignment to prevent binding in the drum. If cylinder binds in drum, tap with rawhide hammer until it is released.
- (3) Remove piston (11), drive disc (12) and springs (16). Make sure piston ring is not damaged or binding.
- (4) Turn drum over and remove snap ring (2), cylinder (15), piston (14) and drive disc (10).

d. Inspection.

- (1) Check all parts for wear or damage.
- (2) Check piston seal rings (5, 6, fig. 29) to ensure freedom in their grooves.
- (3) Replace worn or damaged parts as authorized.

e. Assembly and Installation.

- (1) Install reverse drive disc (14), piston (10) and cylinder (15). Make sure cylinder and piston do not bind in

drum or on dowel pins. Install large snap ring (2) holding cylinder in place.

- (2) Turn drum over and install springs (16), drive disc (11), piston (10) and cylinder (4).
- (3) Place assembly in arbor press. Apply pressure on turbine shaft, making sure cylinder does not bind in drum or on dowel pins (12). Install large snap ring holding cylinder in place and release pressure in arbor press.
- (4) To reinstall on truck reverse removal procedure.

31. Torque Converter and Pump Assembly

a. Converter.

- (1) *Description.* The torque converter is composed of three members: the impeller or driving member, the turbine or driven member and the stator or reaction member. The impeller forms the outer shell of the converter, and the turbine and stator operate within the impeller but turn free of the impeller. The complete unit is mounted

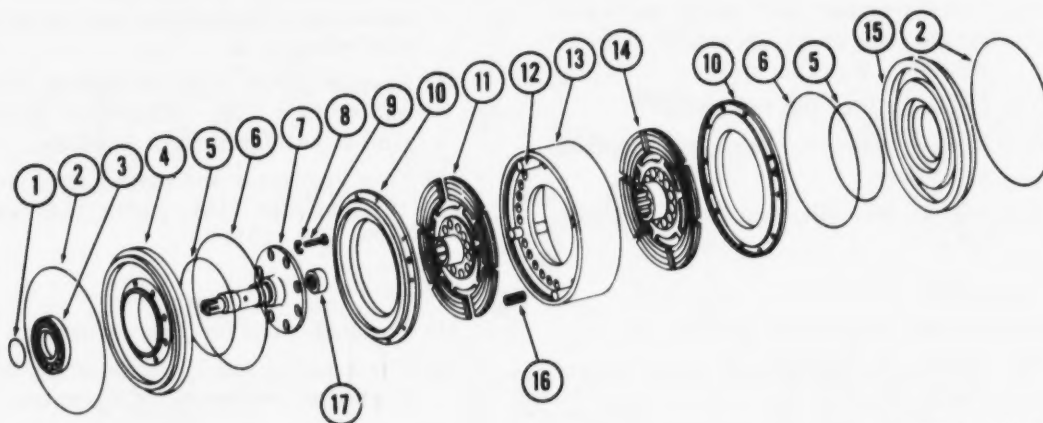
on the engine flywheel and always turns at engine speed. See Figure 20.

The torque converter is filled with oil and when the impeller is rotated by the engine, the oil in the impeller vanes also rotates; and being subjected to centrifugal force, causes the oil to flow outward.

At the beginning the turbine is stationary, and there is no centrifugal force on the oil in it. Therefore, the oil in the impeller, due to its centrifugal force, enters the turbine near its outer circumference and forces oil from the turbine back into the impeller near its inner circumference. A circulation of oil is set up, which continues as long as there is a difference between the speeds of the impeller and turbine.

In normal Lift Truck operation the turbine generally turns at a slower speed than the impeller and since both are the same dimension, the centrifugal force on the oil in the impeller is always greater than on the oil in the turbine. It is this difference plus the pressurized oil from the pump which causes the oil to circulate in and through the converter.

From the above it can be seen that the oil in the converter has a dual motion. It travels



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- | | | |
|------------------|-------------------------|-------------------------|
| 1 Snap ring | 7 Input shaft | 13 Plate assembly |
| 2 Snap ring | 8 Lockwasher | 14 Reverse hub assembly |
| 3 Ball bearing | 9 Hex head bolt | 15 Rear cylinder |
| 4 Front cylinder | 10 Disc piston | 16 Spring |
| 5 Seal ring | 11 Forward hub assembly | 17 Needle bearing |
| 6 Seal ring | 12 Pin | |

Figure 29. Drum and disc assembly.

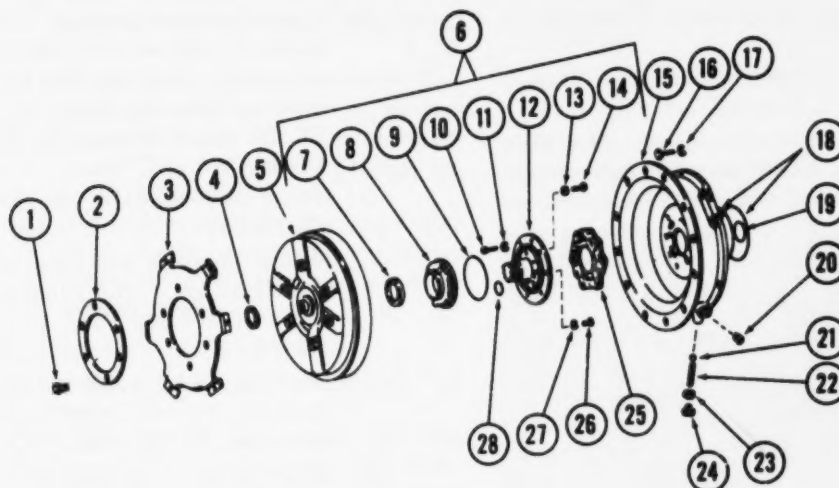
with the impeller and turbine around the outer circumference of the converter and it also flows around the inner circumference or central core of the converter. As a result of these motions the oil carries a certain amount of kinetic energy. The velocity of the oil in the converter increases as the oil passes from the impeller to the turbine and decreases as it passes from the turbine back to the impeller.

Since the velocity increases in the impeller, its kinetic energy increases and this gain in kinetic energy can come only from the impeller. That is to say, when increasing the velocity of oil in its vanes, the impeller encounters a resistance, and it takes power (from the engine) to keep the impeller running against this resistance. In the turbine the oil is slowed down and presses forward against the vanes, and when the turbine is moving under this force, power to drive the truck is produced. Thus, all

the oil passing through the impeller picks up energy and gives it to the turbine. Up to this point operation is the same as a fluid coupling and there is no torque multiplication.

To transmit velocity to the oil at the inner circumference of the converter, a third member or stator is added to the fluid coupling, between the impeller and the turbine. It is here the fluid coupling becomes a torque converter. With the impeller rotating and the turbine stalled, the oil is driven through the curved blades of the turbine. The curved blades redirect the oil in the opposite direction from which it was received. As the oil leaves the turbine blades, it strikes the stator blades causing a reaction which produces torque multiplication.

The stator directs the oil back to the impeller where any remaining kinetic energy combines with the kinetic energy of the impeller oil, producing additional torque multiplication. When



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- | | | |
|----------------------|----------------------|----------------------|
| 1 Bolt | 11 Lockwasher | 21 Ball |
| 2 Reinforcing plate | 12 Collector ring | 22 Spring |
| 3 Drive plate | 13 Lockwasher | 23 Flat washer |
| 4 Shim | 14 Hex head screw | 24 Spring seat |
| 5 Converter assembly | 15 Transmission case | 25 Support gasket |
| 6 Pump assembly | 16 Capscrew | 26 Hex head screw |
| 7 Oil seal | 17 Lockwasher | 27 Lockwasher |
| 8 Pump support | 18 Seal ring | 28 Preformed packing |
| 9 Preformed packing | 19 Seal ring | |
| 10 Hex head bolt | 20 Pipe plug | |

Figure 30. Torque converter and pump assembly.

the output torque becomes high enough the turbine starts to turn and the truck will move. As the turbine speeds up and its speed approaches the impeller speed, there is no longer any reaction in the stator and it starts to turn with the turbine. At this point the unit becomes a fluid coupling since there is no longer any torque multiplication.

(2) *Removal and disassembly.* Refer to Paragraph 28.

(3) *Cleaning and inspection.*

- (a) Clean all parts in approved solvents and dry with compressed air.
- (b) Check all parts for excessive wear, warping, cracks and other damage.

(4) *Assembly and installation.*

- (a) Without shims (4, fig. 30) on pilot, install converter on flywheel. Tighten capscrews.
- (b) Place scale across tangs of converter and another scale from flywheel housing face to the first scale (fig. 31).
- (c) Record measurement from face of tangs to housing face.
- (d) If measurement is less than $2\frac{31}{32}$ inches (2.968 inches) remove converter and add shims (4, fig. 30) at



Figure 31. Checking converter tank depth.

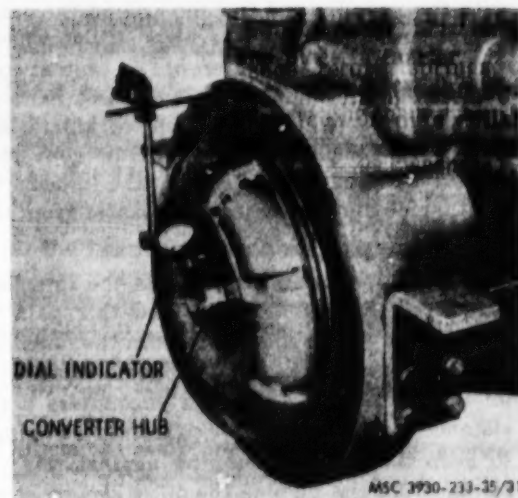


Figure 32. Checking converter alignment.

converter pilot to obtain specified dimension.

- (e) If measurement is more than $2\frac{63}{64}$ inches (2.982 inches) insert a suitable gasket between the converter housing (15) and flywheel housing (8, fig. 9) to obtain the specified dimension.
- (f) Mount dial indicator as shown in Figure 31.
- (g) Rotate converter and note dial indicator readings. Hub runout should not exceed 0.005 inch (0.01 inch T.I.R.).
- (h) Bend converter plate to adjust to specified dial reading. Do not use shims between plate and flywheel.
- (i) After correct alignment is obtained for (e) above, recheck tank depth in (a) through (c) above.
- (j) Refer to Paragraph 28 for proper installation procedures.

b. Transmission Pump Assembly.

- (1) *Description.* The gear type oil pump provides hydraulic pressure for the converter and the clutch pack. It is directly driven from the input side of the converter. Since the converter is mounted on the engine flywheel, the

pump is in operation whenever the engine is running. This means that there is hydraulic pressure even with the engine idling.

With the converter pump operating, the oil is taken from the sump and pumped under a pressure between 100 P.S.I. and 150 P.S.I., to the converter and to the pressure regulator of the control valve.

(2) **Removal.** Refer to Paragraph 28.

(3) **Disassembly.**

- (a) Remove capscrews (14, 26, fig. 30) holding pump to collector ring (12), and separate pump from ring.
- (b) Remove seal rings (9, 28) and oil seal (7).
- (c) Remove pump collector ring bushing if worn or damaged.

(4) **Cleaning and inspection.**

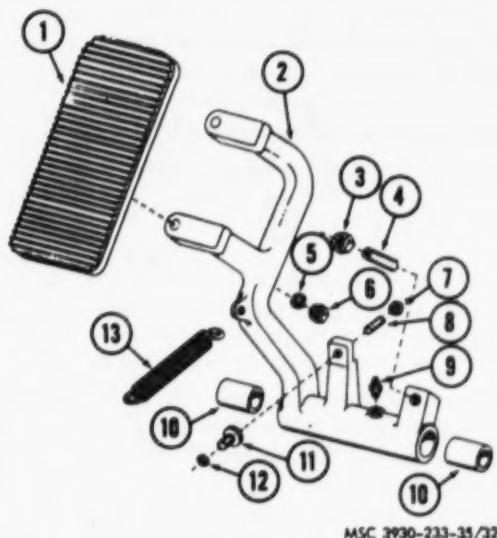
- (a) Clean all metal parts in approved solvents, and dry with compressed air.
- (b) Check pump gears bushings and housing for excess wear or damage.
- (c) Complete pump will have to be replaced if excess wear or damage are noted in (b) above.
- (d) If face of pump collector ring shows score marks from the converter tangs, refer to Paragraph 31, a for correct shimming.

(5) **Assembly and installation.**

- (a) Install new O-rings (9, 28) and oil seals (7).
- (b) Lubricate all parts with light OE.
- (c) Install pump on collector ring (12). Make sure holes are properly aligned.
- (d) Install pump assembly on converter housing (15) using new gasket (25).
- (e) For installation on truck, see Paragraph 28.

32. Inching Pedal

a. **Description.** The inching pedal is installed on the same shaft as the brake pedal, and cannot be removed without removing the brake



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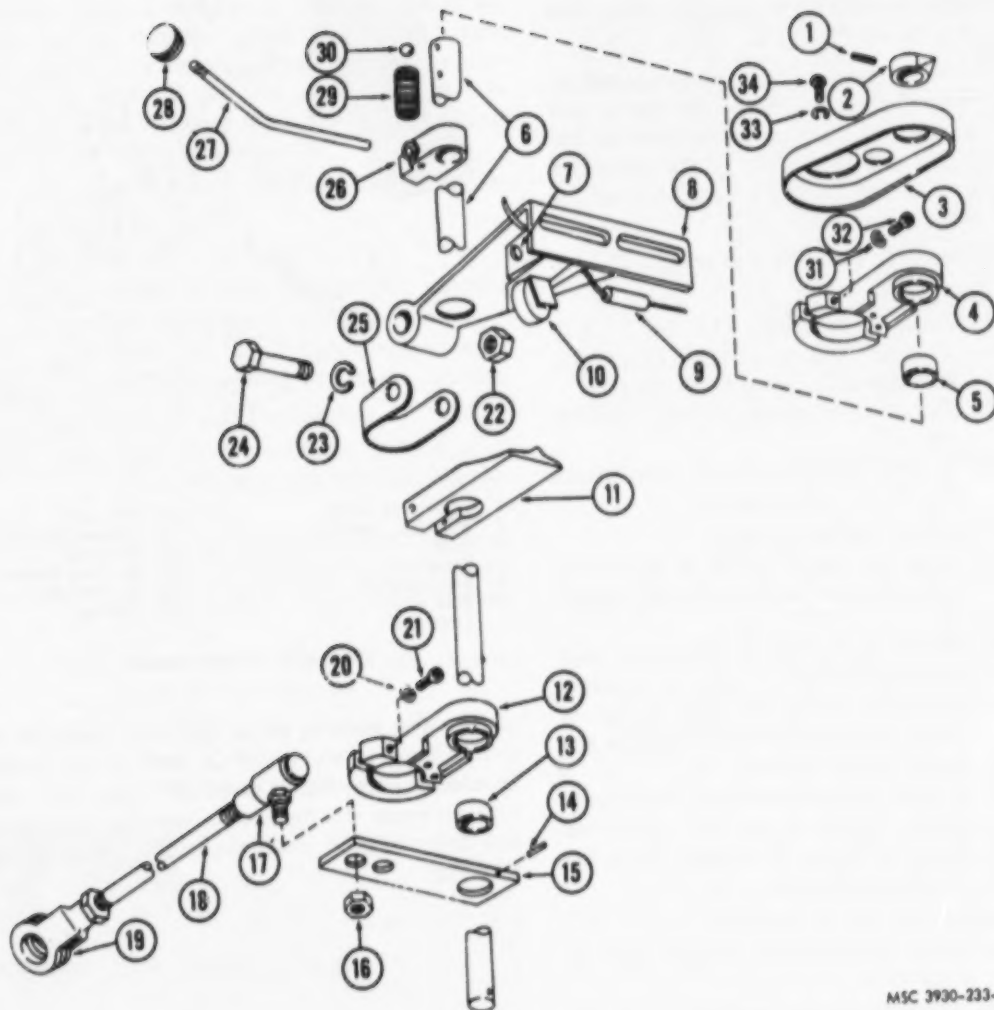
1 Plate assembly	8 Setcrew
2 Treadle assembly	9 Grease fitting
3 Nut	10 Bushing
4 Setcrew	11 Inching button
5 Lockwasher	12 Lockwasher
6 Hex nut	13 Spring
7 Jam nut	

Figure 22. Inching pedal.

pedal. The inching pedal controls operation of the inching valve, which is part of the transmission control valve assembly (par. 29), and also actuates the brakes to provide simultaneous transmission disengagement and position braking.

b. **Removal.**

- (1) Remove floor plates (TM 10-3930-233-20).
- (2) Disconnect master cylinder clevis pin (21, fig. 45) from the brake pedal, and the inching pedal control shaft.
- (3) Remove pedal springs and brake pedal bumper (5, fig. 47).
- (4) Remove roll pin (11) through brake pedal and shaft (4).
- (5) Remove shaft support bearing (13) on steering shaft bracket.
- (6) Pull shaft through bracket far enough to slide brake pedal off shaft.
- (7) Push shaft back through bracket, but drop the free end below the support



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- | | |
|------------------------------|-----------------------|
| 1 Roll pin | 18 Shifting rod |
| 2 Indicator | 19 Yoke |
| 3 Shift bracket | 20 Lockwasher |
| 4 Bracket and clamp assembly | 21 Capscrew |
| 5 Bushing | 22 Nut |
| 6 Lower shifting rod | 23 Lockwasher |
| 7 Micro switch bracket | 24 Capscrew |
| 8 Support | 25 Clip |
| 9 Wire assembly | 26 Stop |
| 10 Micro switch | 27 Upper shifting rod |
| 11 Lever | 28 Knob |
| 12 Mounting bracket | 29 Spring |
| 13 Bushing | 30 Ball |
| 14 Roll pin | 31 Lockwasher |
| 15 Shifting lever | 32 Capscrew |
| 16 Nut | 33 Lockwasher |
| 17 Ball joint | 34 Capscrew |

Figure 24. Forward-reverse lever assembly.

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bearing (4) on the right frame member, until shaft drops free.

(8) Slide inching pedal off shaft.

c. Cleaning and Inspection.

(1) Clean all parts with approved solvents and dry with compressed air.

(2) Inspect bushings (10, fig. 33) and shaft for excessive wear.

(3) Inspect treadle assembly for cracks, deformation or other damage.

(4) Replace damaged or worn parts as authorized.

d. Installation.

(1) Reverse removal procedures.

(2) Do not attempt to drive roll pin home until holes in brake pedal and shaft are properly aligned.

e. Adjustment. See TM 10-3930-233-20.

33. Shifting Mechanism

a. Removal.

(1) Remove floor plate (TM 10-3930-233-20) and steering wheel (par. 42).

(2) Remove roll pin (1, fig. 34) holding indicator (2) in position and move indicator up shaft.

(3) Remove capscrews (34) holding cover (3) in place and move out of way.

(4) Remove capscrews from steering column support (8) and the two mounting brackets (4, 12).

(5) Loosen actuating lever capscrew (11).

(6) Remove shifting rod ball joint (17) from bottom of shift lever (15).

(7) Lift mechanism out of truck.

(8) Shift lever can now be removed by removing roll pin (14) from main shift rod (6).

b. Cleaning and Inspection.

(1) Clean all parts in SD and dry.

(2) Inspect all parts for excess wear, deformation, cracks, stripped threads and other damage.

(3) Replace defective parts as authorized.

c. Installation. Install in reverse order of removal.

d. Adjustment.

(1) If shifting mechanism binds, check alignment at mounting bracket (4) on steering column and mounting bracket at bottom of shifting bar (12).

(2) To obtain proper operation of the shifting mechanism it is important that the detent in the indicator plate be synchronized with the detents in the selector valve plunger. Correct synchronization of the detents can be obtained by adjusting the rod assembly between the selector valve plunger and the lever at the bottom of the shifting bar.

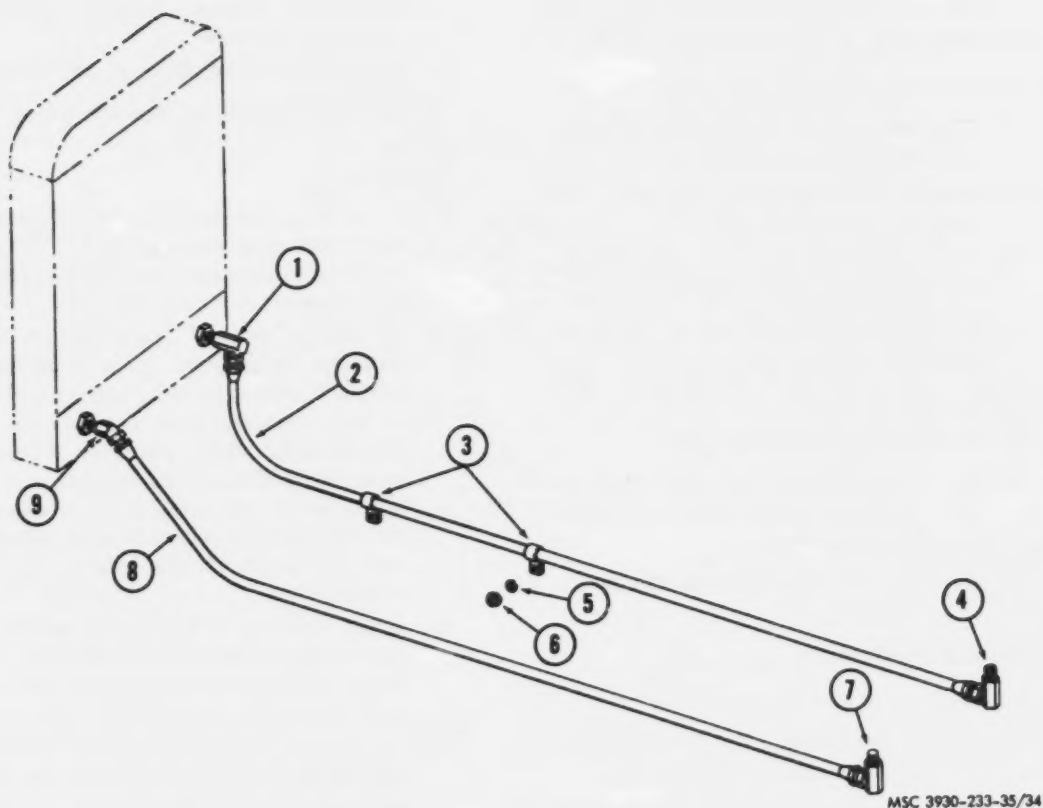
(3) After shifting detents are correctly adjusted, the neutral switch (10) and lever (11) should be adjusted for correct operation.

(4) To adjust, loosen capscrew holding switch lever (11) to shifting rod (6) and with shifting mechanism in neutral move lever so that switch lever is at lowest point on cam, making sure switch is in off position.

(5) Then tighten capscrew in switch cam. Move shifting lever to either forward or reverse position, turn ignition key to start. If engine does not start, adjustment is correctly made.

34. Oil Cooler

An oil cooler is installed in the "Power Shift" hydraulic system to control the temperature of the oil being delivered to the clutch pack. The cooler unit is located in the bottom tank of the radiator. If oil appears in engine coolant it indicates a leak has developed in oil cooler. Cooler must be repaired or replaced immediately. Refer to Paragraph 25 for *Inspection, Repair and Installation* of radiator.



- | | | |
|---------------|---------------|---------------|
| 1 90° Adapter | 4 90° Adapter | 7 90° Adapter |
| 2 Hose | 5 Lockwasher | 8 Hose |
| 3 Clamp | 6 Nut | 9 45° Adapter |

Figure 35. Oil cooler connections.

Section VII. UNIVERSAL JOINT

35. Universal Joint

a. Description.

The universal joint assembly is of a heavy duty industrial type consisting of two trunnion bearing assemblies, a center coupling plate and an output flange. Very little service is normally required of this assembly, other than periodic repacking of the bearings.

b. Removal.

- (1) Remove wires and capscrews (6, fig. 36) holding universal joints to the

pinion shaft flange (5, fig. 36) and slip joint (34, fig. 21).

- (2) Slide the output shaft slip joint into transmission and remove universal joint.

c. Disassembly.

- (1) Remove lockwires (1, fig. 36) and capscrews (8).
- (2) Separate bearing assemblies (2, 4) from coupling plate (?).

- (3) Remove lockwires (7) and capscrews (6) holding output flange (5) to bearing assembly.

d. Cleaning and Inspection.

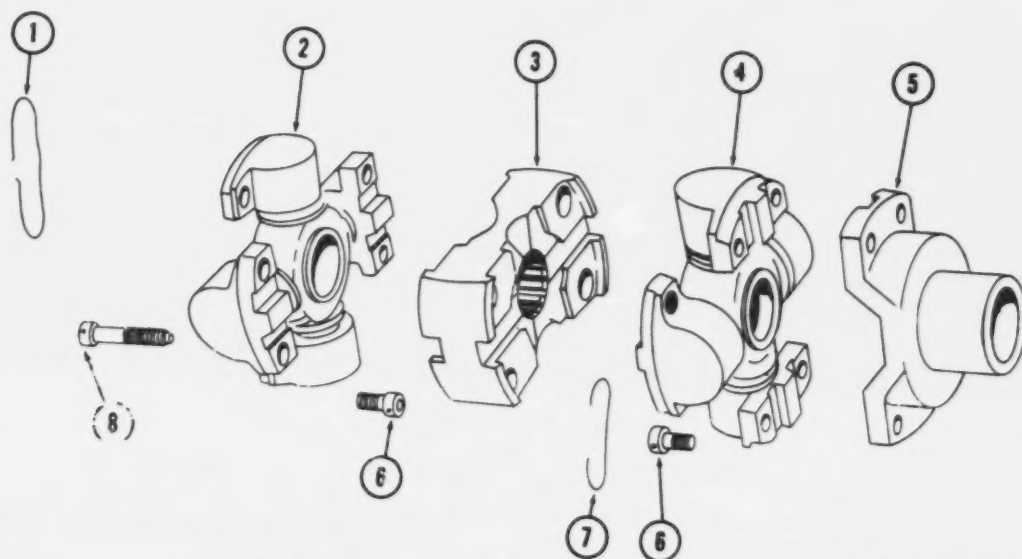
- (1) Clean all parts in SD and dry.
- (2) Inspect bearing assemblies for freedom of movement, and for excess wear or damage.

- (3) Check coupling plate output flange and all capscrews for stripped threads or other damage.

- (4) Replace defective parts as authorized.

e. Assembly. Reverse procedures in *c* above.

f. Installation. Refer to TM 10-3930-233-20.



- 1 Lockwire
- 2 Cross assembly
- 3 Center plate
- 4 Cross assembly

- 5 Transmission output flange
- 6 Screw
- 7 Lockwire
- 8 Screw

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Figure 36. Universal joint.

Section VIII. DRIVE AXLE

36. Drive Axle Assembly

The drive assembly is a double reduction, full-floating, internal gear drive. The drive wheel, bevel drive pinion, and differential assembly are supported by tapered roller bearings. The axle drive shafts are supported by double thrust bearings. The differential carrier is mounted at the center of the drive axle housing. The differential consists of two parts, the carrier assembly and case assembly. The bevel ring gear is bolted to the differential case.

which houses the spider and side gears. The pinion gear is mounted in the differential carrier. Double reduction is obtained by means of internal tooth ring gears mounted inside the drive wheels, which are driven by pinion gears mounted at the wheel ends of the axle shafts.

37. Axle Shafts

a. Removal.

- (1) Remove wheels, hubs and brake drums (TM 10-3930-233-20).

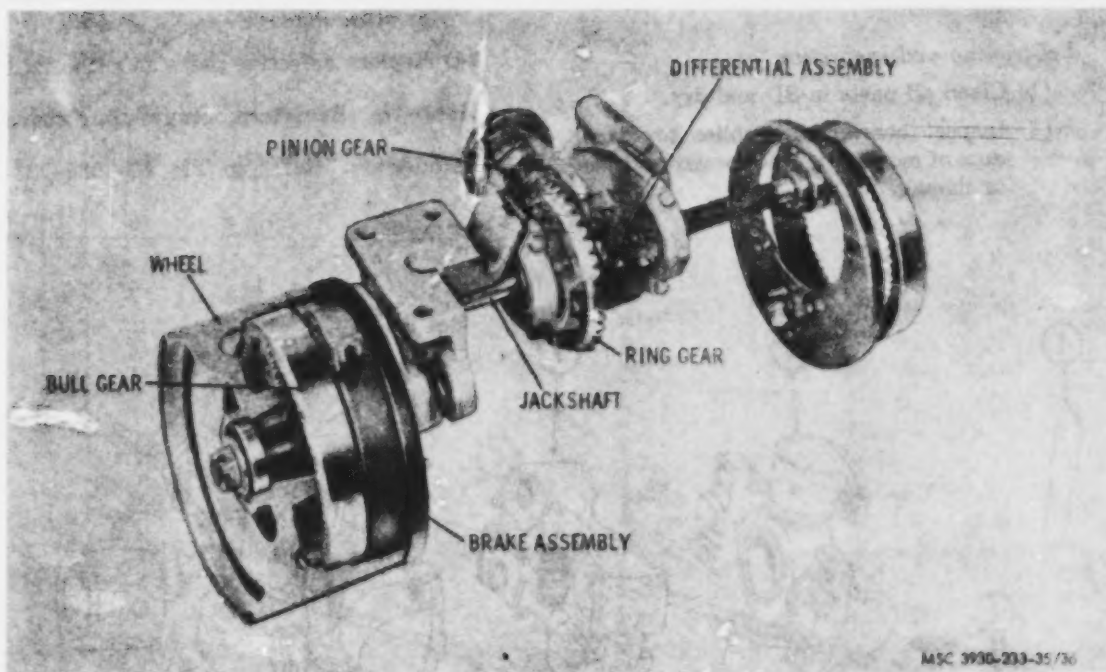


Figure 37. Drive unit.

- (2) Remove two capscrews (12, fig. 39) holding dust shield (10) and remove shield.
- (3) Remove two capscrews holding axle caps (18).
- (4) Install threaded puller into threaded end of axle shaft and, using care, remove shaft. Axle shaft bearing assembly will be pulled with the shaft.
- (5) Straighten locking prongs of axle shaft lockwasher (23), and remove locknut (24) and lockwasher.
- (6) Place axle in suitable press and remove bearings (20).
- (7) Remove axle bearing cup (21).

b. Cleaning and Inspection.

- (1) Clean all parts with SD.

- (2) Inspect all parts for excessive wear or damage.
- (3) Replace worn or damaged parts as authorized.

c. Assembly and Installation.

- (1) Replace all seals.
- (2) To assemble and install, reverse procedures in *a* above.
- (3) Use a soft mallet to drive axle shaft splines into differential.

38. Spindles

a. Removal.

- (1) Remove wheel assembly (TM 10-3930-233-20).
- (2) Remove dust shield (par. 37, *a*).
- (3) Remove cotter pin (31, fig. 38), locknut (30) and washer (29), from spin-

dle (28) at back side of drive axle housing.

- (4) Install spindle puller and remove (Fig. 39).

b. Inspection.

- (1) Inspect spindle and hardware for damage.
- (2) Replace damaged parts as authorized.

c. Installation.

- (1) Align spindle in drive axle housing, then install washer (29) fig. 38 and lock nut (30).
- (2) Tighten nut until spindle is fully seated.
- (3) Install cotter pin (31).
- (4) To complete installation reverse procedures in *a* above.

39. Differential Assembly

a. Removal.

- (1) Remove wheel assemblies (TM 10-3930-233-20).

- (2) Remove axle shafts (par 37, a).

- (3) Remove differential cover (5, fig. 38).

- (4) Remove lockwires (14, fig. 40) and capscrews (13), and remove carrier caps (12).

- (5) Remove differential case (20, 29) with attached bearing adjusting nuts (38), bearings (39), and bearing cups (Fig. 40).

- (6) Remove cotter pin (1, fig. 40), pinion flange nut (2), and flange (3).

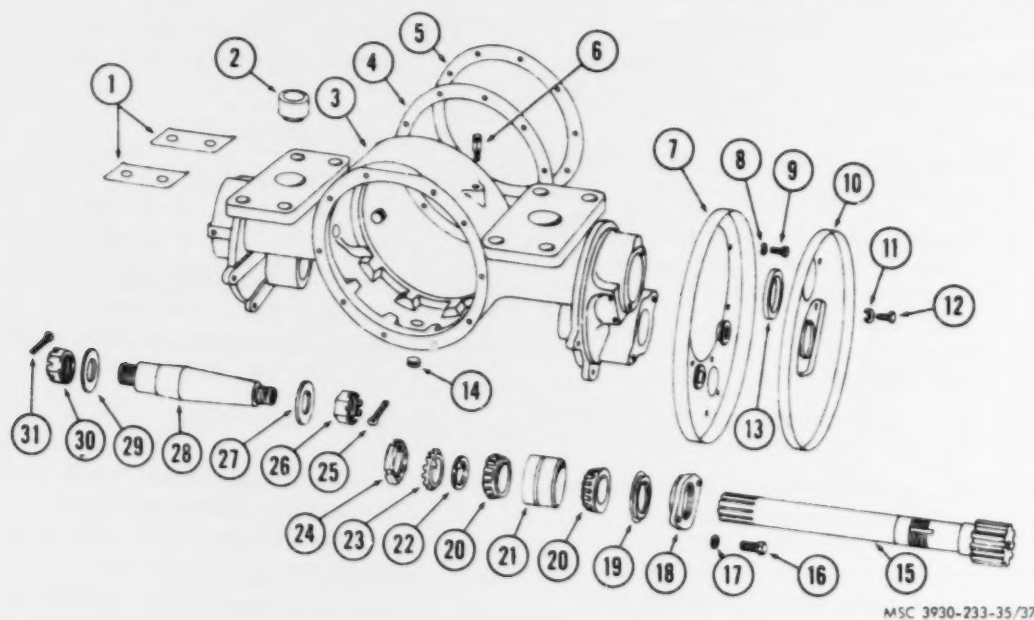
- (7) Place carrier (11) in press and press pinion (18) out of carrier. Spacer (8) and shims (7) may be removed with pinion.

Note. If carrier housing is to be re-used, do not lose or damage shims, since they may be re-used if not damaged.

b. Disassembly.

- (1) Remove pinion shaft front bearing (5) with suitable bearing puller.

- (2) Remove pinion shaft rear bearing (17)



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1 Shim	9 Capscrew	17 Lockwasher	25 Cotter pin
2 Dowel pin	10 Dust and grease shield	18 Cap	26 Nut
3 Housing assembly	11 Lockwasher	19 Oil seal	27 Washer
4 Gasket	12 Capscrew	20 Bearing cone	28 Spindle
5 Cover	13 Oil seal	21 Bearing cup	29 Special washer
6 Breather	14 Magnetic pipe plug	22 Tongued washer	30 Nut
7 Brake backup plate	15 Axle pinion shaft	23 Lockwasher	31 Cotter pin
8 Lockwasher	16 Capscrew	24 Bearing locknut	

Figure 38. Drive axle housing and shafts.



Figure 39. Removing spindle.

from carrier (11) by tapping out with a brass drift. Also remove oil seal.

- (3) Remove differential bearings (39) with suitable bearing puller.
- (4) Remove lockwires (31) and capscrews (30) holding case halves (20, 29) together.
- (5) Remove plain case (29), spider pinion gears (26), and thrust washers (27).
- (6) Remove differential ring gear (18) by removing lockwires (27) and special capscrews (21) holding it to flanged case.

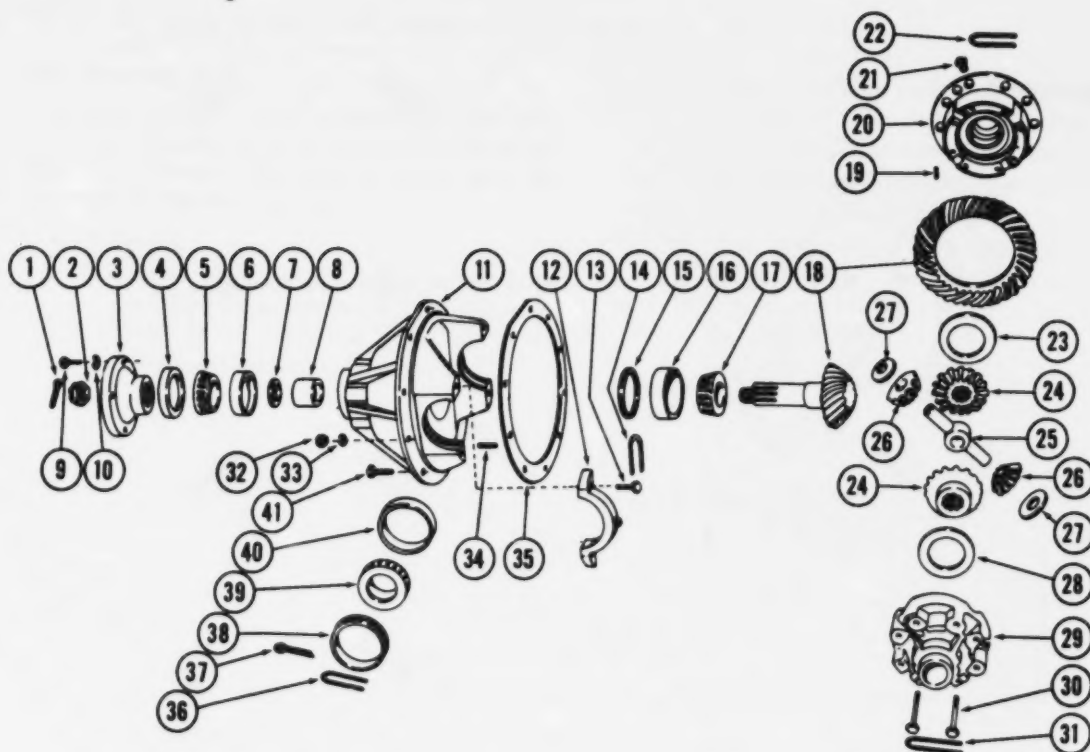
c. Cleaning and Inspection.

- (1) Clean all parts with approved solvents and dry with compressed air.
- (2) Inspect all parts for cracks, chips, excessive wear or other damage.

d. Assembly.

- (1) Press front and rear pinion bearing cups (6, 16) into differential carrier. Be sure they are firmly seated.
- (3) Install rear bearing cone (5), pinion flange (3) and nut (2).
- (4) Torque pinion nut to 15 to 25 inch-pounds, and spin pinion to seat bearings.

- (2) Press front bearing cone (17), onto pinion shaft and place in carrier.
 - (5) Check dimensions between face of pinion and O.D. surface of differential case. The required dimension is 0.156 ± 0.002 inch for a pinion etch marked 0.000. If pinion is marked -0.004 , required dimension and required dimension determines the thickness of the shim pack necessary to set the pinion properly. Shim pack should be compressed when measured with micrometer.
 - (6) Remove pinion and install shim pack between front bearing cone and pinion gear.
 - (7) Reassemble with spacer (8), rear shims (7), new oil seal (4), pinion flange (3) and pinion nut (2).
 - (8) Torque pinion nut to 15 to 25 inch-pounds.
 - (9) Recheck dimension with feeler gauge. Dimension required is 0.156 ± 0.002 inch.
 - (10) Install cotter pin (1).
 - (11) Install two dowels (19) in differential ring gear (18), align dowels with dowel holes in flanged case (20).
 - (12) Install special ring gear capscrews (21) and draw ring gear into place tighten capscrews and lock in place with lockwires (22).
 - (13) Place thrust washer (23) in bottom of flanged case (20). Install side gear (24), spider (25), spider pinions (26), pinion thrust washers (27), and opposite side gear (24). Install plain case (29).
- Note.* Be certain that the case match marks are aligned.
- (14) Install differential case capscrews (30) and tighten. Install lockwires (31).
 - (15) Install bearings (39) and cups (40) on differential case.

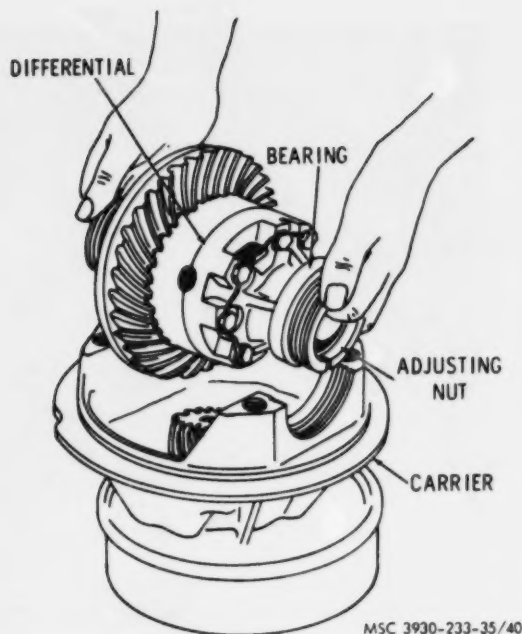


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- | | | |
|-----------------------------|------------------------------|--------------------|
| 1 Cotter pin | 15 Shims (as required) | 29 Plain case half |
| 2 Nut | 16 Bearing cup | 30 Bolt |
| 3 Flange | 17 Bearing cone | 31 Lockwire |
| 4 Oil seal | 18 Pinion-ring gear assembly | 32 Nut |
| 5 Bearing cone | 19 Groove pin | 33 Washer |
| 6 Bearing cup | 20 Flanged case half | 34 Stud |
| 7 Pinion shim (as required) | 21 Capscrew | 35 Gasket |
| 8 Pinion spacer | 22 Lockwire | 36 Lockwire |
| 9 Capscrew | 23 Thrust washer | 37 Cotter pin |
| 10 Lockwasher | 24 Side gear | 38 Nut |
| 11 Carrier housing assembly | 25 Cross pin | 39 Bearing cone |
| 12 Bearing cap | 26 Pinion | 40 Bearing cup |
| 13 Capscrew | 27 Thrust washer | 41 Bolt |
| 14 Lockwire | 28 Thrust washer | |

Figure 40. Differential assembly.

- (16) Place differential in carrier and engage differential ring gear with pinion (18) in carrier (11).
- (17) Install differential adjusting nuts (38), and caps (12), but do not tighten capscrews (13) in caps at this stage.
Caution: Make certain cups (40) are reinstalled in original positions.
- (18) Coat ring gear with Prussian Blue or white lead to obtain tooth pattern (fig. 42).
- (19) Adjust ring gear laterally for a backlash adjustment of 0.005 to 0.010-inch by means of the differential side bearing adjusting nuts (38). To increase backlash, loosen adjusting nut closest to the ring gear, and tighten the one opposite. To decrease backlash, reverse operation.
- (20) With the drive pinion properly installed and adjusted, rotate the pinion and hold back on the ring gear to create the effect of a load. After several



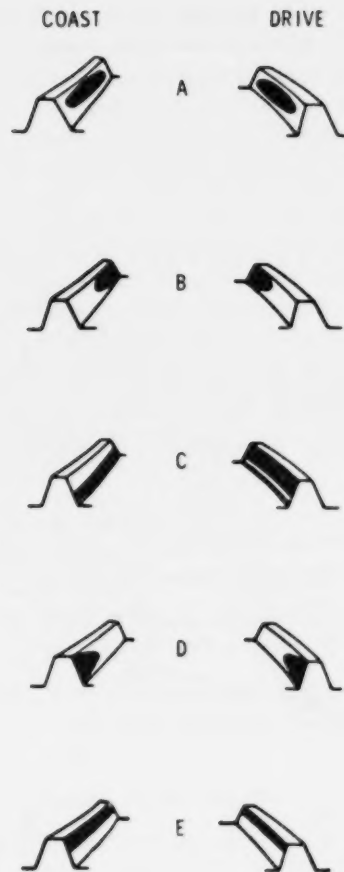
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Figure 41. Removing differential from carrier.

rotations of the drive pinion, inspect the teeth of the pinion where the paint has been removed by gear contact. Compare the tooth bearing (area where paint was removed) with figure 41. The tooth bearing should start at a point about $\frac{1}{32}$ to $\frac{1}{16}$ inch from the top of the tooth and continue downward to a point about $\frac{1}{32}$ to $\frac{1}{16}$ inch from the bottom of the tooth.

Note. Do not be concerned with the amount of paint removed from the front toward the rear of the tooth. The amount of paint removed is determined by the amount of load applied while rotating the drive pinion and ring gear. The tooth bearing should always be more toward the toe end, or a toe bearing.

- (21) After proper backlash and tooth pattern are obtained, fully tighten cap-screws holding bearing caps in place and wire in position.
- (22) If hole for cotter key (in cap) does not line up with hole in adjusting nut, redrill hole and install cotter key. Key should be wired in place with bearing cap cap screws.



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- A—Correct adjustment.
- B—Heavy contact on toe of tooth. To correct move ring gear away from pinion. Move pinion towards ring gear to again secure correct backlash.
- C—Bearing too low. Heavy contact on flank of tooth. To correct this move pinion away from ring gear until contact comes to full working depth of gear tooth without breaking contact at flank. Move ring gear towards pinion to secure proper backlash.
- D—Heavy contact at heel of tooth. To correct move ring gear towards pinion. Move pinion away from gear to obtain correct backlash.
- E—Shows heavy contact on tooth face. Move pinion towards gear until contact covers flank of tooth without breaking contact at face. Move gear away from pinion to secure correct backlash.

Figure 42. Differential gear tooth patterns.

- (23) Position new gasket on mounting flange of differential and coat with a suitable leak proof adhesive.
- (24) Install differential assembly in drive unit and install cap screws.

Note. Use copper washers on cap screws located below oil level of differential.

Section IX. STEERING AXLE

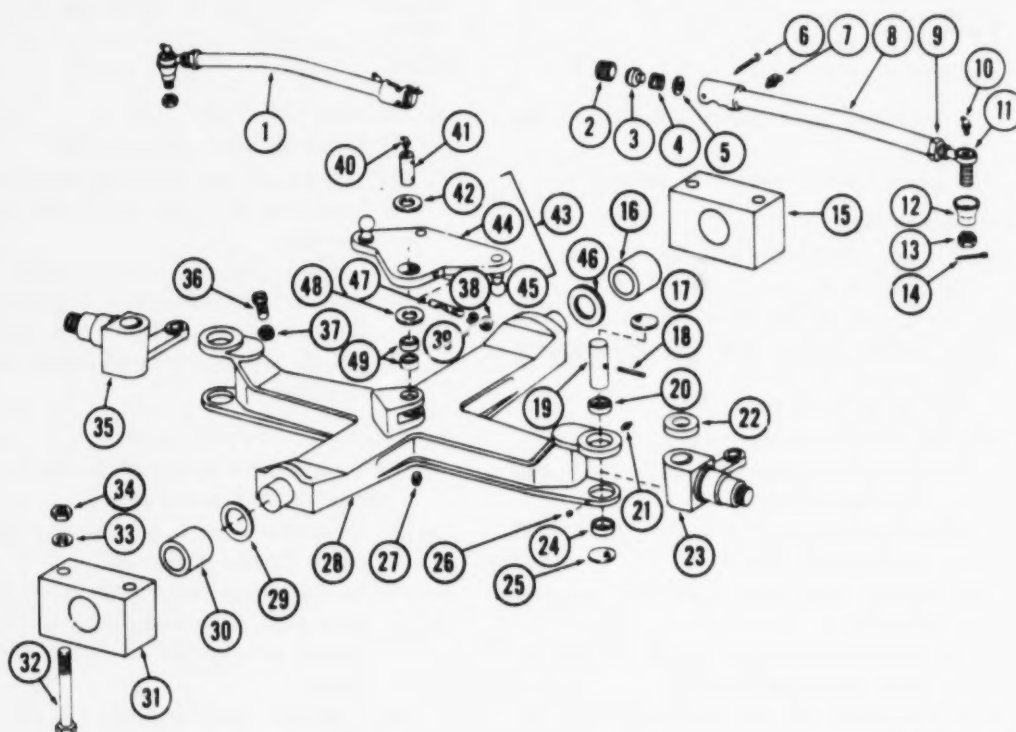
40. Steering Axle

a. Description. The cruciform, trunnion mounted, steering axle is mounted in torsional plastic bushings. The inclined king pins are mounted in needle bearing.

b. Removal.

- (1) Raise rear end of truck with chain hoist to an accessible height and support in this position with blocks or other authorized safe means.

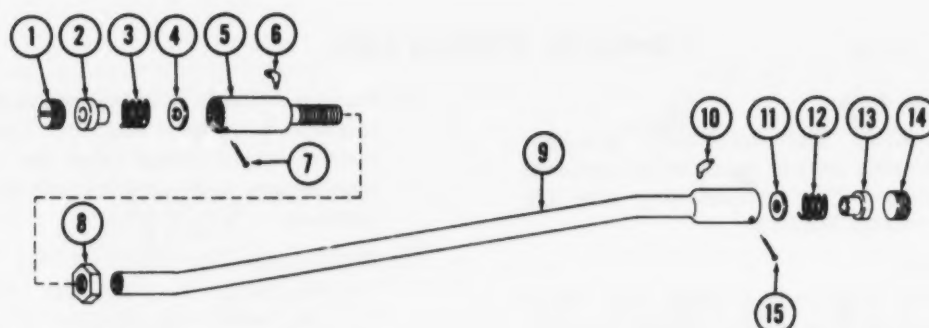
- (2) Place a suitable jack under the steering axle to raise it slightly. This removes weight stress from the trunnion blocks, and supports axle during removal.
- (3) Remove the drag link (fig. 44) from the ball stud on the pivot arm (44, fig. 43), by loosening adjusting plug (1, fig. 44) at end of drag link.
- (4) Remove four capscrews attaching the



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1 Tie rod assembly	14 Cotter pin	26 1/4 inch pipe plug	38 Nut
2 Adjusting plug	15 Mounting block	27 1/4 inch pipe plug	39 Lockwasher
3 Ball seat	16 Plastic bushing	28 Steer axle	40 Grease fitting
4 Spring	17 Expansion plug	29 Spacing washer	41 Pivot arm pin
5 Washer	18 Roll pin	30 Plastic bushing	42 Washer
6 Cotter pin	19 King pin	31 Mounting block	43 Pivot arm assembly
7 Grease fitting	20 Needle bearing	32 Capscrew	44 Pivot arm
8 Tie rod	21 Grease fitting	33 Flat washer	45 Ball stud
9 Jam nut	22 Thrust bearing	34 Nut	46 Spacing washer
10 Grease fitting	23 Left hand spindle	35 Right hand spindle	47 Wedge bolt
11 Ball socket	24 Needle bearing	36 Capscrew	48 Washer
12 Cover	25 Expansion plug	37 Nut	49 Pivot bushing

Figure 43. Steering axle.



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1 Adjusting plug	5 Socket assembly	9 Tube	13 Ball seat
2 Ball seat	6 65° grease fitting	10 65° grease fitting	14 Plug
3 Spring	7 Cotter pin	11 Washer	15 Cotter pin
4 Washer	8 Nut	12 Spring	

Figure 44. Drag link.

trunnion block assemblies (31, 15, fig. 43).

(5) Lower axle assembly to ground.

c. Disassembly.

- (1) Remove tie rods (1, 8, fig. 43) by:
 - (a) Removing nuts (13).
 - (b) Loosening adjusting plugs (2), ball seats (3), springs (4) and washers (5).
 - (c) Remove tie rods.
- (2) Remove pivot arm (44) by:
 - (a) Remove wedge bolt nut (38) and washer (39).
 - (b) Remove pivot arm pin (41) and wedge bolt (47).
- (3) Remove king pins (19) and spindles (23, 35) by:
 - (a) Remove expansion plugs (17, 25) at each end of king pins.
 - (b) Remove roll pin from spindles and king pins.
 - (c) Tap king pins out of axles and remove spindles.

d. Cleaning and Inspection.

- (1) Clean all metal parts in SD.
- (2) Inspect all moving parts, bearings and hardware for wear, corrosion or other damage.
- (3) Inspect trunnion block plastic bushings for deterioration, cracking, and fit with trunnion block and trunnion.
- (4) Worn, or deteriorated parts as authorized.

e. Assembly and Installation.

- (1) To assemble and install, reverse procedures in *b* and *c* above.
- (2) Be certain to lubricate the moving parts during assembly.
- (3) Be certain to align roll pin holes in king pins (19) and spindles (23, 35) before attempting to drive roll pins home.
- (4) Tighten adjusting plugs (2) then back off just enough so that there is no end play, then secure plug with cotter pin. For adjustment see Paragraph 42, *e*.

Section X. BRAKES

41. Service and Hand Brakes

a. Description of Service Brake. The hydraulic brake system is of the full floating, self centering, self adjusting type which consists of a mechanically activated master cylinder transmitting hydraulic pressure through heavy duty

brake lines to wheel cylinders. The wheel cylinders are of the double ended type, with actuating links extending from each end of the cylinders. The links transmit movement from the cylinders to the brake shoes. The top of each shoe moves freely in a wear plate, while the

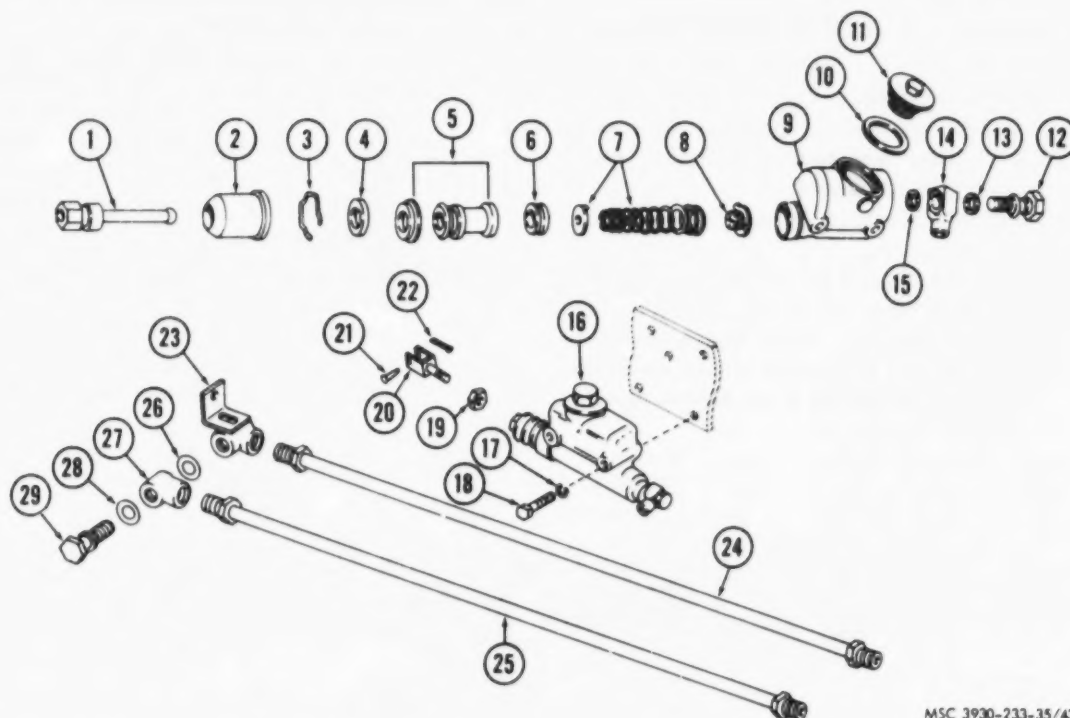
bottom of the shoe transfers movement from the hydraulic wheel cylinders. Wear adjustment for brake linings is made automatically in normal use by the self adjusting mechanism. The shoes are held against the brake wear plates, wheel cylinder links, and adjusting eccentrics by tension springs which maintain the shoes in equilibrium.

b. Brake Drums.

- (1) Removal: Refer to (TM 10-3930-233-20).
- (2) Cleaning: Refer to (TM 10-3930-233-20).
- (3) Inspection and Repair.
 - (a) Check inside diameter of brake drum at 45° intervals, around cir-

cumference, using a micrometer or diameter bar and thickness gauges. If diameter difference exceeds 0.010 inch or radius difference exceeds 0.005 inch, resurface drum.

- (b) Examine drum for scoring or heat checking. Resurface drum if score marks can be felt or any heat checking can be seen. Heat check cracks form cutting edges which quickly shave off lining surfaces.
- (c) Check drums for "bell mounted" or "barrel shaped" wear by placing drum on drum lathe and advancing tool until it contacts drum at its high points. Then advance tool to contact low points. Measure the



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1 Piston rod	9 Cylinder and tank	16 Master cylinder assembly	23 Tee
2 Boot	10 Gasket	17 Lockwasher	24 Line
3 Lockwire	11 Filler plug	18 Capscrew	25 Wheel line
4 Stop plate	12 Outlet bolt	19 Jam nut	26 Gasket
5 Piston assembly	13 Gasket	20 Yoke	27 Fitting
6 Piston cup	14 Fitting	21 Yoke pin	28 Gasket
7 Spring and retainer	15 Gasket	22 Cotter pin	29 Bolt

Figure 15 Master cylinder.

difference and resurface the drum if difference exceeds 0.005 inch (radius).

Note. Always resurface drums in pairs, and machine them to the same diameter, since different diameters can cause unbalanced and hazardous braking. Finish grind or hone resurfaced drums to remove tool marks which can cause rapid wear if not removed.

- (4) Assembly and installation. Refer to (TM 10-3930-233-20).

c. Master Cylinder.

- (1) Description. The brake master cylinder and fluid reservoir are combined in one casting, and are joined by intake and by-pass ports in the cylinder wall. Internal parts are removable at the pushrod end.
- (2) Removal. Refer to (TM 10-3930-233-20).
- (3) Disassembly.

- (a) Secure master cylinder in a vise, using care not to distort or crack cylinder casting.
- (b) Remove boot (2, fig. 45) and push rod (1).
- (c) Hold piston in cylinder and remove lock wire (3) by gentle prying.

Caution: When lock wire is removed, the entire piston assembly will spring out if not held in place.

- (d) Carefully remove copper stop plate (4), piston (5), rubber cup (6), spring (7), and valve (8).
- (e) Working from the other end of cylinder remove outlet fitting bolt (12), washer (13), brake line fitting (14), and gasket (15).
- (f) Remove filler cap (11) and gasket (10).

(4) Cleaning and Inspection.

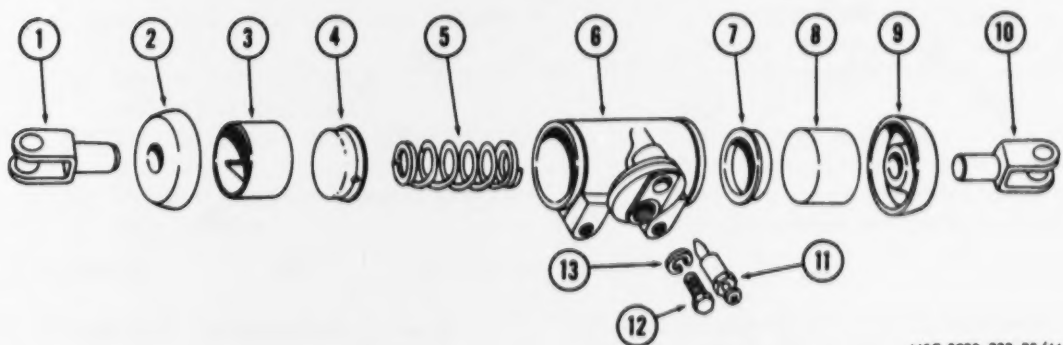
- (a) Clean all parts with denatured alcohol or brake fluid, and keep clean in all following operations.

Warning: Dirty parts or internal rubber parts which become swollen, tacky and otherwise deteriorated by mineral base cleaning solvents, can lead to brake failure and possible injury to the operator.

- (b) Inspect cylinder bore. Deep blemishes require reboring to surface the cylinder wall. Pressure marks may be polished out with crocus cloth.

Caution: Do not use emery cloth or sandpaper.

- (c) Make sure intake and by-pass ports are open. By-pass ports may be probed with soft iron wire.
- (d) If it is necessary to resurface the cylinder wall, follow the honing



- 1 Connecting link
- 2 Boot
- 3 Piston
- 4 Piston cup

- 5 Spring
- 6 Cylinder body
- 7 Piston cup

- 8 Piston
- 9 Boot
- 10 Connecting link

- 11 Bleeder
- 12 Capscrew
- 13 Lockwasher

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Figure 46. Brake wheel cylinders.

equipment manufacturers recommendations. Do not hone cylinder oversize.

- (e) Before assembly, inspect parts for corrosion, scratched or pitted piston bearing surfaces, rubber deterioration, and defective spring action. Replace worn, damaged, corroded or deteriorated parts as authorized.

- (5) Assembly Installation. Refer to (TM 10-3930-233-20).

4. Wheel Cylinders.

- (1) *Description.* The hydraulic wheel cylinder houses two opposed pistons which actuate two opposed brake shoes. Pistons, rubber cups, and springs are held in the cylinder by pressure from the brake shoes. Open ends of the cylinder are protected by rubber boots.

- (2) *Removal.* Remove wheel and wheel cylinder (TM 10-3930-233-20).

(3) Disassembly.

- (a) Remove rubber boots (2, fig. 46) from cylinder ends.

- (b) Push out internal parts.

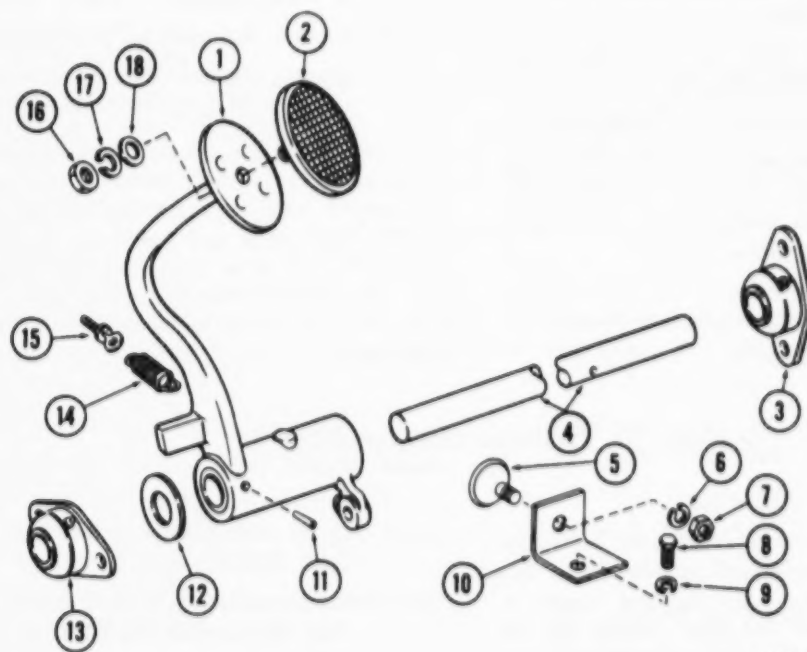
- (4) *Cleaning and Inspection.* Use the same procedures for cleaning and inspection as those used for the master cylinder in d above. Obey the same warning. Replace defective parts as authorized.

- (5) *Assembly and Installation.* Assemble in reverse order of disassembly using figure 46 as a guide. Refer to (TM 10-3930-233-20) for installation.

e. Brake Pedal.

- (1) *Removal.* Refer to Paragraph 32.

- (2) *Disassembly.*



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- | | | | |
|------------------|--------------|-------------------|--------------------|
| 1 Brake pedal | 6 Lockwasher | 11 Roll pin | 15 Adjusting screw |
| 2 Pedal pad | 7 Lockwasher | 12 Washer | 16 Nut |
| 3 Flange bearing | 8 Capscrew | 13 Flange bearing | 17 Lockwasher |
| 4 Pedal shaft | 9 Lockwasher | 14 Spring | 18 Washer |
| 5 Bumper | 10 Bracket | | |

Figure 47. Brake pedal.

- (a) Remove nut (16, fig. 47), and washers (17, 18).
- (b) Remove foot pad (2).
- (3) *Inspection.* Inspect all parts for excess wear for damage, and replace defective parts as authorized.
- (4) *Installation.* Refer to Paragraph 32.
- (5) *Adjustment and tests.* Refer to (TM 10-3930-233-20).

f. Description of Hand Brake. The hand brake is a fully enclosed, two shoe mechanical brake, designed so that equal pressure is applied to both shoes when the brake lever is actuated. The hand brake should be adjusted as often as necessary to maintain satisfactory operation. Never allow linings to wear beyond point where shoes contact brake drum.

g. Removal and Disassembly.

- (1) Remove floor and tow plates (TM 10-3920-233-20).
- (2) Disconnect yoke from brake lever (TM 10-3930-233-20).
- (3) Remove universal joint (par. 35).
- (4) Remove lockwire (25, fig. 48), capscrews (24), and lockwashers (23) and remove brake drum (22) from differential pinion flange.
- (5) Remove cotter pin (1, fig. 41) and nut (2), then remove pinion flange (3) from pinion shaft.

- (6) Remove brake lever (19, fig. 48) and rollers from backing plate (15).
- (7) Remove brake shoe return springs (21) and slide shoe and lining assembly off backing plate (15).
- (8) Remove capscrews (17), lockwashers (16) and backing plate (15) from differential carrier housing assembly (11, fig. 41).

h. Inspection.

- (1) Check backing plate (15, fig. 48) for distortion, loose or sheared rivets, and worn pawls.
- (2) Check brake lining for wear or grease saturation.
- (3) Check brake shoes for worn pawl holes, lever contact areas, or wear pads.
- (4) Check brake drum for cracks, scoring or other damage.
- (5) Replace damaged parts as authorized.
- (6) Always replace shoe return springs (21, fig. 48) during reassembly.

i. Reassembly and Installation. Reassembly and installation is the reverse of removal and disassembly with the exception of lightly coating the wear pads and pawls on the backing plate (15), the lever (19) and the brake shoe (20) wear points with brake lubricant. Avoid excessive lubricant as grease soaked linings are dangerous.

Section XI. STEERING SYSTEM (GROUP 14)

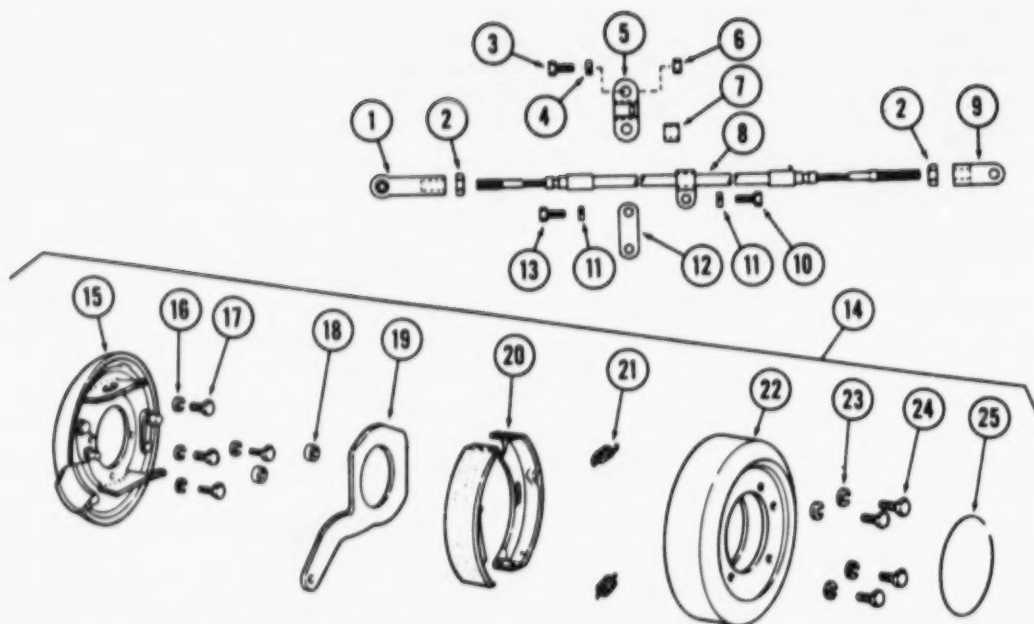
42. Steering Gear Assembly

a. Description. The steering gear assembly is a conventional worm and gear type unit, actuated by movement of the steering wheel. A pitman arm actuates the steer wheels via tie rods and drag links. A horn button and wiring are installed in the steering wheel.

b. Removal.

- (1) Remove floor and tow plates (TM 10-3930-233-20).
- (2) Remove shifting mechanism (par. 33).

- (3) Remove nut (20, fig. 49), washer (21), and pitman arm (22) from shaft (32).
- (4) Remove nut (22, fig. 24) and capscrew (24) holding clamp (25) to bracket (8).
- (5) Remove capscrews holding steering gear case to support bracket.
- (6) Free horn button wire at connector and remove steering gear assembly from truck.



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1 Clevis	8 Brake cable	14 Parking brake assembly	20 Brake Shoes
2 Nut	9 Clevis	15 Backing plate	21 Return spring
3 Capscrew	10 Capscrew	16 Lockwasher	22 Brake drum
4 Lockwasher	11 Lockwasher	17 Capscrew	23 Lockwasher
5 Clip	12 Bracket	18 Roller	24 Capscrews
6 Nut	13 Capscrew	19 Brake lever	25 Lockwire
7 Spacer			

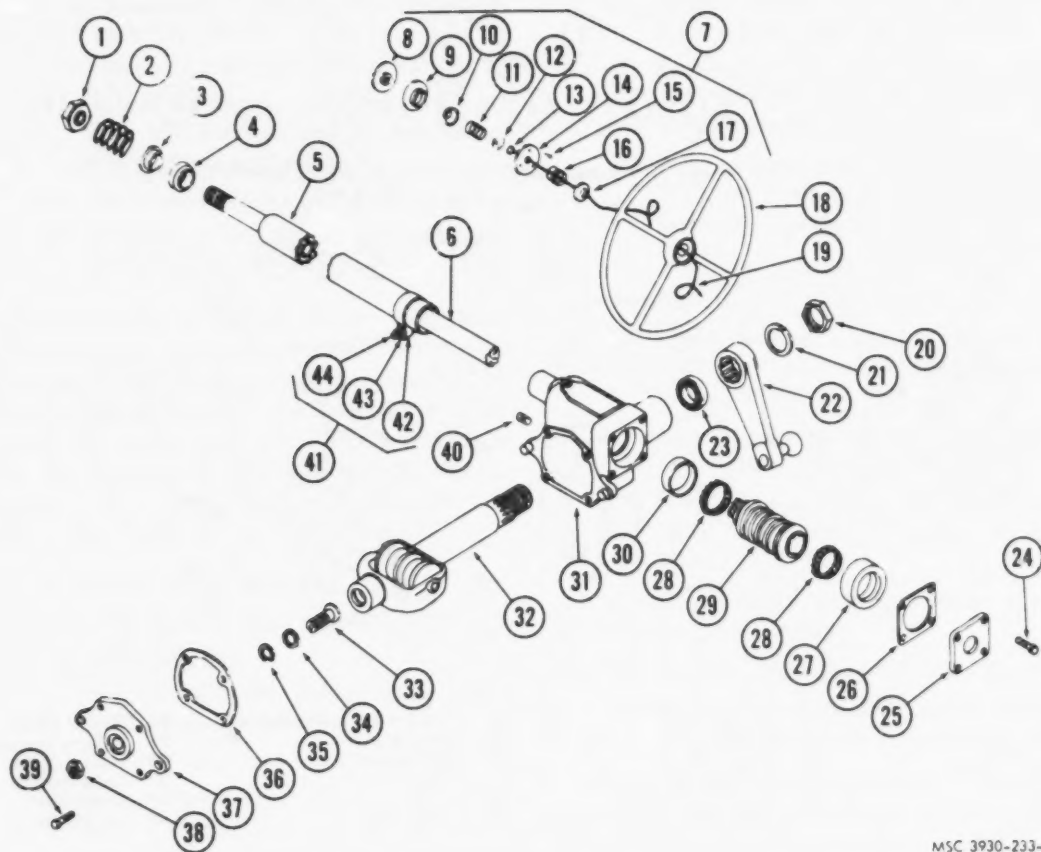
Figure 48. Hand brake.

c. Disassembly.

- (1) Remove filler plug (40) and drain oil from gear housing.
- (2) Remove horn button assembly.
- (3) Remove nut (1) from column assembly (6).
- (4) Use suitable puller to remove steering wheel (18).
- (5) Remove spring (2) and clamp (45) then remove jacket tube.
- (6) Remove screws (39), shaft cover (32), adjusting screw (33), washers (34, 35) and nut (38) as a unit.
- (7) Remove gasket (36) from housing and, nut (38) and adjusting screw (33) from shaft cover.
- (8) Remove shaft (32).
- (9) Remove capscrews (24), cover (25), and shim (26).
- (10) Press cups (27, 30), bearings (28), worm (29) and column (6) out of housing.
- (11) Remove oil seal (23) from housing.

d. Cleaning and Inspection.

- (1) Clean all parts with approved solvents.
- (2) Inspect shafts, column, worm gears, pitman arm, jacket tube, housing and steering wheel for cracks, scoring, broken teeth, damaged threads, excessive wear and other damage.
- (3) Inspect bearings for out of round, cracks, scoring, or other defects.



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- | | | |
|----------------------------|-------------------------|----------------------------|
| 1 Wheel retaining nut | 16 Spring | 31 Gear Assembly housing |
| 2 Spring | 17 Washer | 32 Pitman arm shaft |
| 3 Spacer | 18 Steering wheel | 33 Shaft adjusting screw |
| 4 Bearing | 19 Horn cable | 34 Thrust washer |
| 5 Tube assembly | 20 Pitman retaining nut | 35 Snap ring |
| 6 Steering column and worm | 21 Lockwasher | 36 Cover gasket |
| 7 Horn assembly | 22 Pitman arm | 37 Shaft cover |
| 8 Horn cover | 23 Oil seal | 38 Adjusting screw jam nut |
| 9 Horn button | 24 Screw | 39 Screw |
| 10 Cap | 25 Worm gear cover | 40 Filler plug |
| 11 Spring | 26 Shim (as required) | 41 Clamp assembly |
| 12 Cup | 27 Bearing cup | 42 Lockwasher |
| 13 Ferrule | 28 Bearings | 43 Nut |
| 14 Base plate | 29 Worm gear | 44 Bolt |
| 15 Roundhead screw | 30 Bearing cup | |

Figure 49. Steering gear.

e. Repair and Replacement.

- (1) Repair housing and hardware by welding if practical.
- (2) Repair damaged threads by using appropriate tap or die if possible.
- (3) Replace all gaskets and seals with new units.

- (4) Replace defective items with serviceable ones as authorized.

f. Assembly and Adjustment.

- (1) Reverse procedures in *b* above.
- (2) Remove capscrews (24) holding cover (25) to housing (31).

- (3) With drag link removed from pitman arm, add just enough shims, between housing and cover, to provide a slight drag when steering wheel is turned (1 to 1½ pounds drag). Secure cover.
- (4) When assembly is complete, make the following adjustment:
 - (a) Locate center position of steering wheel by turning wheel all the way in one direction, then all the way in the other. Count the turns from one stop to the other. Bring the wheel back to the center position.

- (b) Turn adjusting screw (33) inward until a slight drag is felt when turning the steering wheel (2½ pounds drag). This indicates the correct centering of the worm shaft (29).
- (c) Tighten adjusting screw lock nut (38). Be sure to hold adjusting screw in position described in (b) above while tightening nut.

g. Installation. Reverse procedures in *a* above.

Section XII. BODY

43. Seat Cushions and Frame

a. Description. The chassis of the truck is of heavy duty industrial type, designed to provide maximum rigidity and strength. The seat assembly is mounted above the engine compartment.

b. Removing, Disassembling, and Installing. Refer to TM 10-3930-233-20.

c. Inspecting and Repairing.

- (1) Inspect cushions for wear, rips, and other damage. If possible to do so, recover cushions as authorized.
- (2) Inspect seat frame for bends, breaks, and distortions, straighten bends, and use welding procedures to repair breaks if possible.
- (3) Replace defective items as authorized.

Section XIII. MISCELLANEOUS

44. Forks

a. Description. The forks are hook type, attached to the fork lift carriage by upper and lower hangers. The forks are locked in place with locking pins which are installed in the top of each fork, and seat in notches along the top of the upper carriage bar.

b. Removal.

- (1) Lower fork carriage until heel of fork just clears floor.
- (2) Release locking pin (4, fig. 50) and slide fork to a position over the cut out in the lower carriage bar.
- (3) Tilt lower portion of fork forward and up, releasing lower hanger from lower carriage bar.
- (4) Lift fork off upper carriage bar.

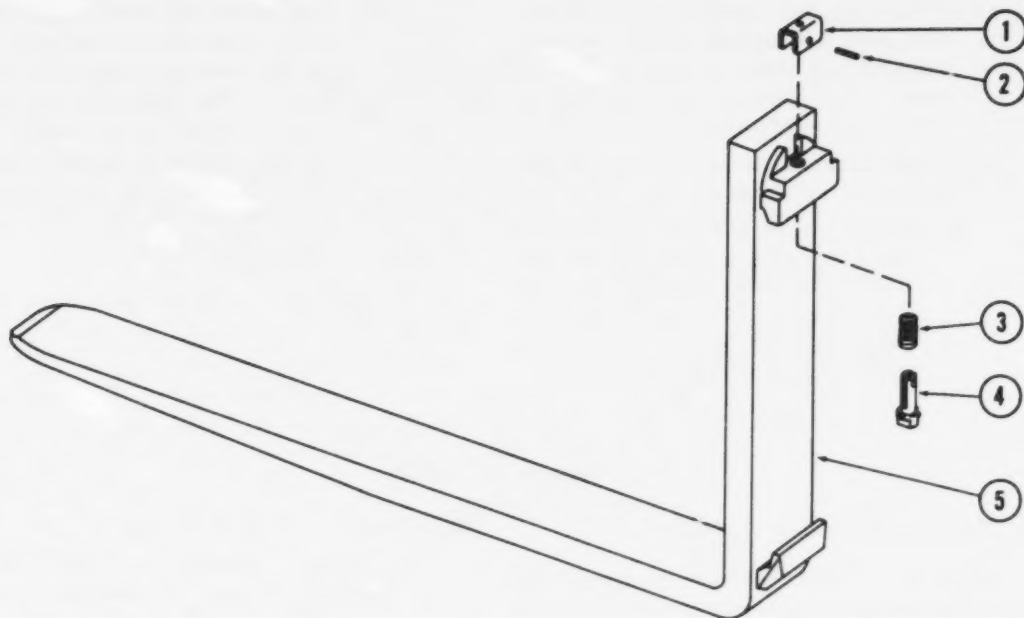
c. Inspection and Repair.

- (1) Inspect fork and locking mechanism for signs of wear or damage.
- (2) If locking mechanism is worn or damaged, remove and replace it as a unit, and weld in place.
- (3) If fork is defective, replace as authorized.

d. Installation. Install by direct reversal of Removal procedures in *b* above.

45. Counterweight

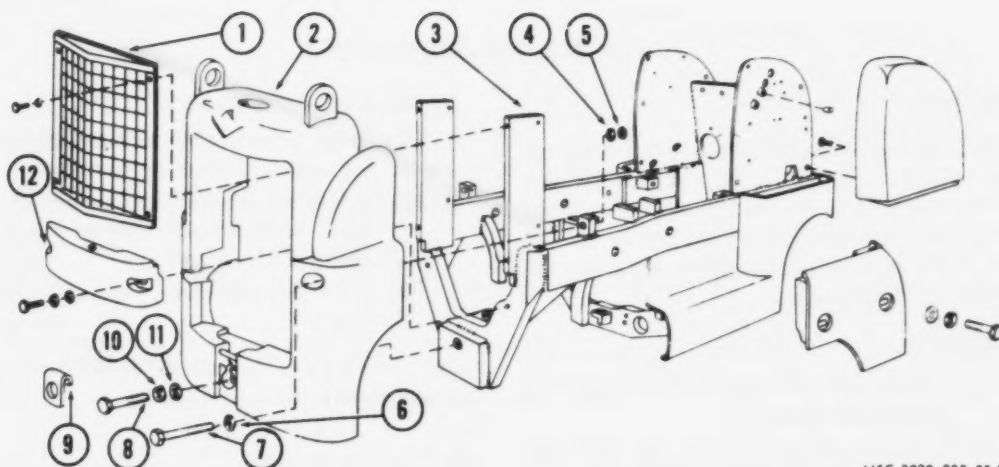
a. Description. The counterweight is a large casting mounted on the rear end of the truck, surrounding the radiator, which is designed to counter any tendency for a heavy load to tip the truck forward, raise the rear wheels, and possibly endanger load and driver.



MSC 3930-233-35/46. 1

- 1 Cover 2 Roll pin 3 Spring 4 Lock pin 5 Fork

Figure 50. Fork.



MSC 3930-233-35 '46. 2

- | | |
|-----------------|---------------|
| 1 Grille | 7 Capcrew |
| 2 Counterweight | 8 Bolt |
| 3 Frame | 9 Towing eye |
| 4 Lockwasher | 10 Lockwasher |
| 5 Nut | 11 Washer |
| 6 Washer | 12 Panel |

Figure 51. Counterweight.

b. Removal.

- (1) Attach sling and hoist to lifting eyes on the counterweight.
- (2) Raise hoist enough to take weight of counterweight off frame.
- (3) Remove nuts (5, fig. 51), washer (6), lockwashers (4), and capscrews (7) at sides of counterweight.
- (4) Remove washer (11), lockwasher (10) and bolt (9) from bottom of counterweight.

- (5) Remove counterweight (2).

c. Inspection and Repair.

- (1) Inspect counterweight for cracks or breaks, and if possible repair by welding.
- (2) Inspect attaching hardware for cracks, breaks, stripped threads or other damage.
- (3) Replace defective parts as authorized.

d. Installation. Install by direct reversal of Removal procedures in *b* above.

Section XIV. HYDRAULIC LIFT

46. Hydraulic Lift System

a. Description.

The hydraulic system is comprised of an oil supply tank, a hydraulic pump coupled to engine crankshaft at rear of truck, dual control valve, lift cylinder, tilt cylinder and the necessary hydraulic hose connections. The lift cylinder is mounted in the mast. The tilt cylinders are attached to the truck frame and the outer mast assembly which pivots at the drive unit housing.

b. Operation.

The pump is the heart of the hydraulic system. In operation it draws oil out of the oil tank and maintains a constant pressure at the control valve.

When the lift control valve is pulled back, oil is pumped through the control valve, through the hydraulic line to the lift cylinder. Oil pressure in the cylinder raises the piston and lifts the carriage and mast.

When the lift control lever is pushed forward, oil pressure in the lift cylinder is released and the mast and carriage are lowered under the pressure of their own weight.

A leakage return line is installed on units between the lift cylinder and the hydraulic oil tank. Its purpose is to return to the tank any excess oil which may accumulate between the packing and gland nut wiper ring.

When the tilt control lever is pushed forward, oil is pumped through the control valve

to the rear of the tilt cylinder. Oil pressure applied at this point moves the piston forward and tilts the masts forward. At the same time oil in front of the plunger is released and recirculated through the tilt section of the valve.

When the tilt control lever is pulled back, oil is pumped through the control valve to the front of the tilt cylinder. Oil pressure applied at this point moves the piston back resulting in backward tilt of the mast. At the same time oil in back of the plunger is released and recirculated through the valve.

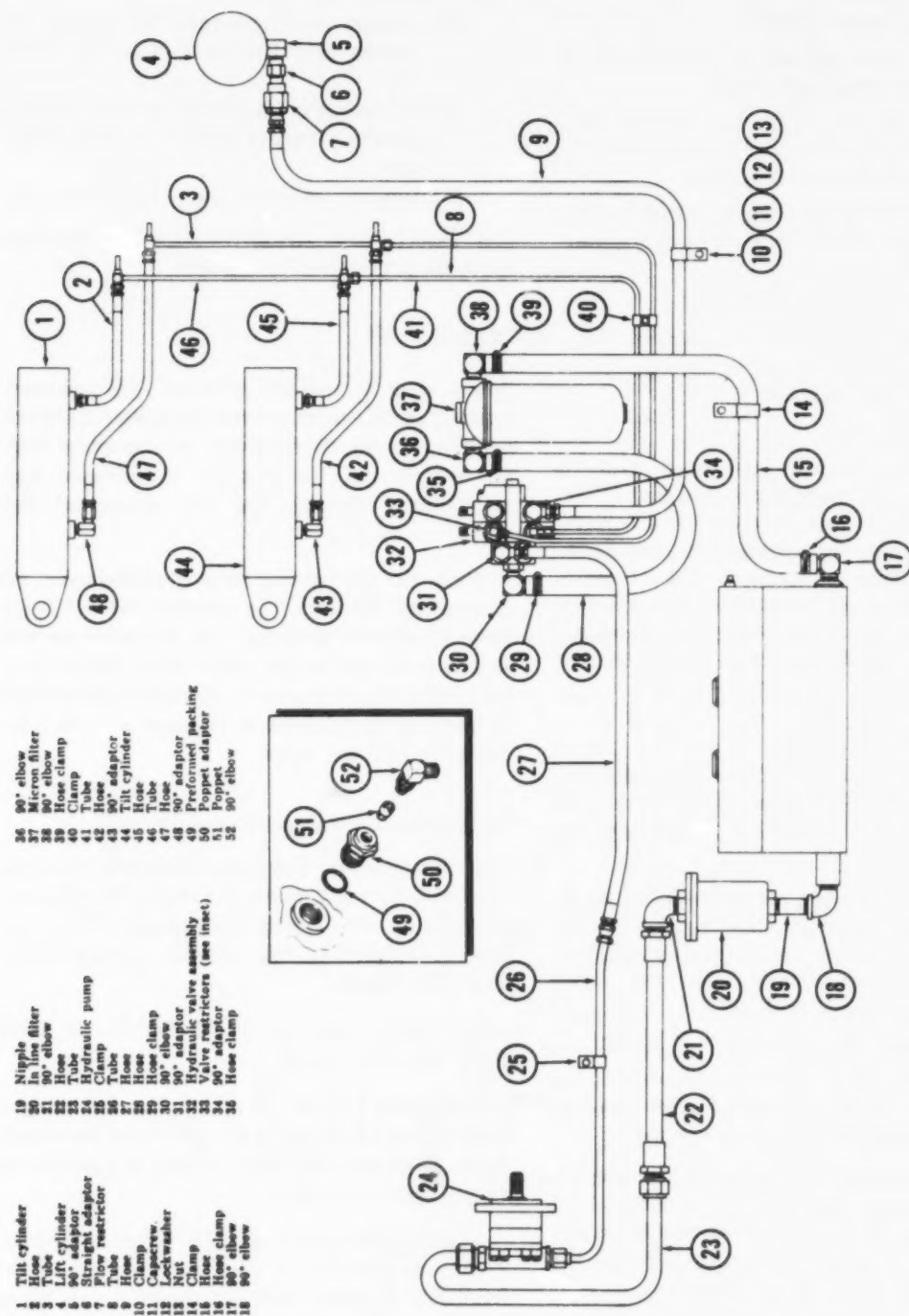
47. Hydraulic Pump Assembly

a. Description. The hydraulic pump is a gear type unit, driven directly through a flexible coupling from the engine crankshaft. With this type of installation, the pump is always driven at engine speed.

The pump capacity is 15 G.P.M. @ 2000 P.S.I. @ 1800 R.P.M.

The pump consists of a housing, two covers, steel gears, bushings, wear plate and necessary seals. Gear end clearance is kept to a minimum by hydraulic pressure.

In some cases when a faulty pump is evident, it may be possible to overhaul the unit in the field. If a clean, well equipped repair shop manned by competent mechanics is available, satisfactory repairs can be accomplished.



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Figure 52. Hydraulic systems schematic.

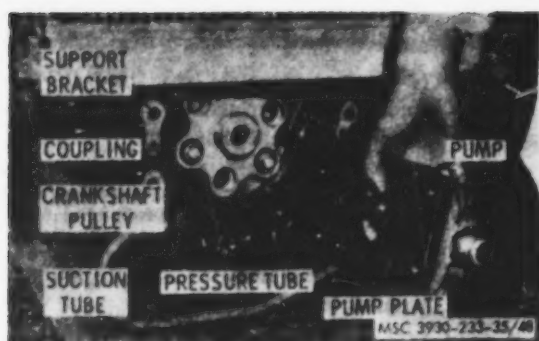


Figure 53. Hydraulic pump removal.

b. Removal.

- (1) Remove radiator grille guard (TM 10-3930-233-20).

- (2) Disconnect hydraulic tubes (23, 26, fig. 52) at fittings on hydraulic pump (fig. 53).

Note. It is not necessary to drain hydraulic reservoir since oil level is below that of the pump fittings.

- (3) Remove capscrews (16, 18, 19, fig. 8) and lockwasher (15, 17, 20) attaching pump plate (14) to pump bracket (13) and timing gear cover (11).

- (4) Remove pump, attached to plate (14), by pulling straight away from engine.

Caution: Do not attempt to remove pump bracket (13) at this time. The rear engine mount is a part of the pump bracket, and any attempt to remove it could result in damage to the

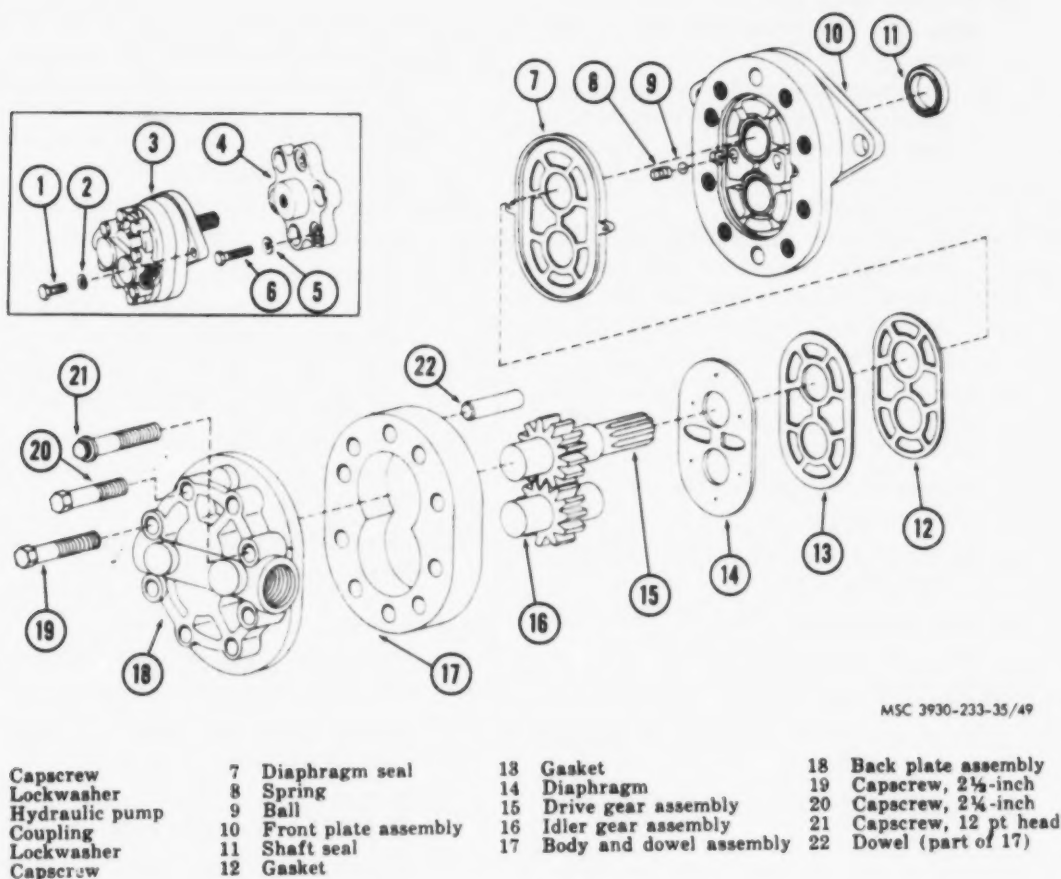


Figure 54. Hydraulic pump.

engine. Refer to Paragraph 16 for bracket removal.

- (5) Loosen capscrews (1, fig. 54) holding pump to plate.
- (6) Loosen pump from plate, then remove capscrews and pump from plate.
- (7) Remove capscrews (6), lockwashers (5), and coupling (4) from crankshaft fan belt pulley (16, fig. 2).

c. Disassembly.

- (1) Clean outside of pump thoroughly with approved solvent.
- (2) Clamp pump in vise, shaft down.
- (3) Remove capscrews (19, 20, 21, fig. 54).
- (4) Remove pump from vise.
- (5) Separate front and back plate assemblies (10, 18) from body and dowel assembly (17) by:
 - (a) Hold pump in hands and bump exposed end of shaft, gently but firmly, against a wooden block. This will normally separate one of the plates from the body.
 - (b) To separate the remaining plate from body, place drive gear into its normal operating position, and tap exposed end of gear shaft with a plastic hammer.
- (6) Remove diaphragm (14) from front plate. Gently pry with a sharp knife edged tool if necessary.
- (7) Remove spring (8) and ball (9) from front plate.
- (8) Remove backup gasket (13) and protector gasket (12).
- (9) Remove diaphragm seal (7), and shaft seal (11).

d. Cleaning and Inspection.

- (1) Clean all parts thoroughly with approved solvents.
- (2) Inspect drive gear shaft for worn splines.
- (3) Inspect both the drive gear and idler gear shafts at bearing points, and seal,

for areas of rough surfaces and excessive wear.

- (4) If shafts measure less than 0.7460-inch in bearing area the gear assembly should be replaced.

Note. Though each gear and its shaft are available only as complete assemblies, each gear assembly may be replaced individually. It is not necessary to replace gears as a set.

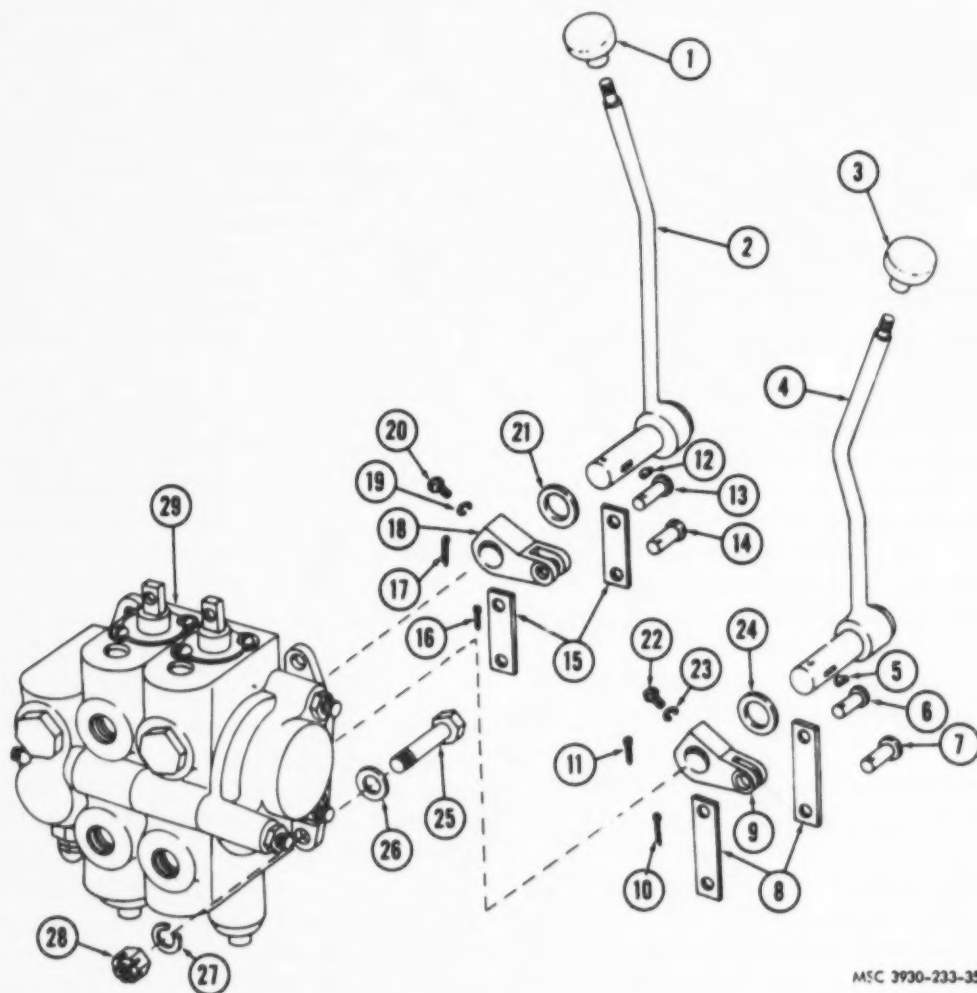
- (5) Inspect gear face for scoring and excessive wear.
- (6) If gear width is less than 1.137-inches, the gear and shaft assembly should be replaced.
- (7) If edges of teeth are sharp, break edges with emery cloth.
- (8) Inspect bearings in both front and back plates. The oil grooves should be half way between horizontal and vertical on the pressure side of the pump.
- (9) If inside diameter of the bearings in front or back plates exceed 0.752-inch, replace the defective plate. Bearings are a part of the plate assemblies, and not available separately.
- (10) Bearings in front plate should be flush with islands in groove pattern.
- (11) Check for scoring on face of back plate. If wear exceeds 0.0015-inch, end plate should be replaced.
- (12) Check inside gear pockets in pump body for excessive scoring or wear.
- (13) Body should be replaced if inside diameter I.D. of gear pocket exceeds 2.002-inches.
- (14) Remove nicks and burrs from all parts with emery cloth.

e. Assembly.

- (1) All seals, gaskets, and diaphragm should be replaced with new parts.
- (2) Install diaphragm seal (7, fig. 54) into recess in front plate (10).
- (3) Install protector and backup gaskets (13, 12) into lip of diaphragm seal.
- (4) Install ball (9) and spring (8) into front plate.

- (5) Install diaphragm into the lip of the diaphragm seal on top of the gaskets, ball and spring.
- (6) Be sure that the entire gasket and diaphragm assembly fits into the diaphragm seal lip.
- (7) Dip gear assemblies (15, 16) into hydraulic oil, and slip into front plate bearings.

- (8) Slip pump body (17) over gears onto front plate. Tap body with a plastic hammer until it is firmly seated against front plate.
- (9) Slide back plate (18) over gear shafts until dowel pins are engaged.
- (10) Install bolts (19, 20, 21) and lockwashers and draw up evenly to 25-foot pounds.



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- | | | | |
|-------------------------------|--------------------------------|------------------|---------------------------|
| 1 Red knob | 9 Control lever | 16 Cotter pin | 23 Lockwasher |
| 2 Tilt handle | 10 Cotter pin | 17 Cotter pin | 24 Washer |
| 3 Black knob | 11 Cotter pin | 18 Control lever | 25 Capscrew |
| 4 Lift handle | 12 Woodruff key | 19 Lockwasher | 26 Flat washer |
| 5 Woodruff key | 13 Yoke pin ($\frac{3}{16}$ " | 20 Capscrew | 27 Lockwasher |
| 6 Yoke pin ($\frac{3}{16}$ " | 14 Yoke pin ($\frac{1}{4}$ " | 21 Washer | 28 Locknut |
| 7 Yoke pin ($\frac{1}{4}$ " | 15 Link | 22 Capscrew | 29 Control valve assembly |
| 8 Link | | | |

Figure 55. Hydraulic control levers.

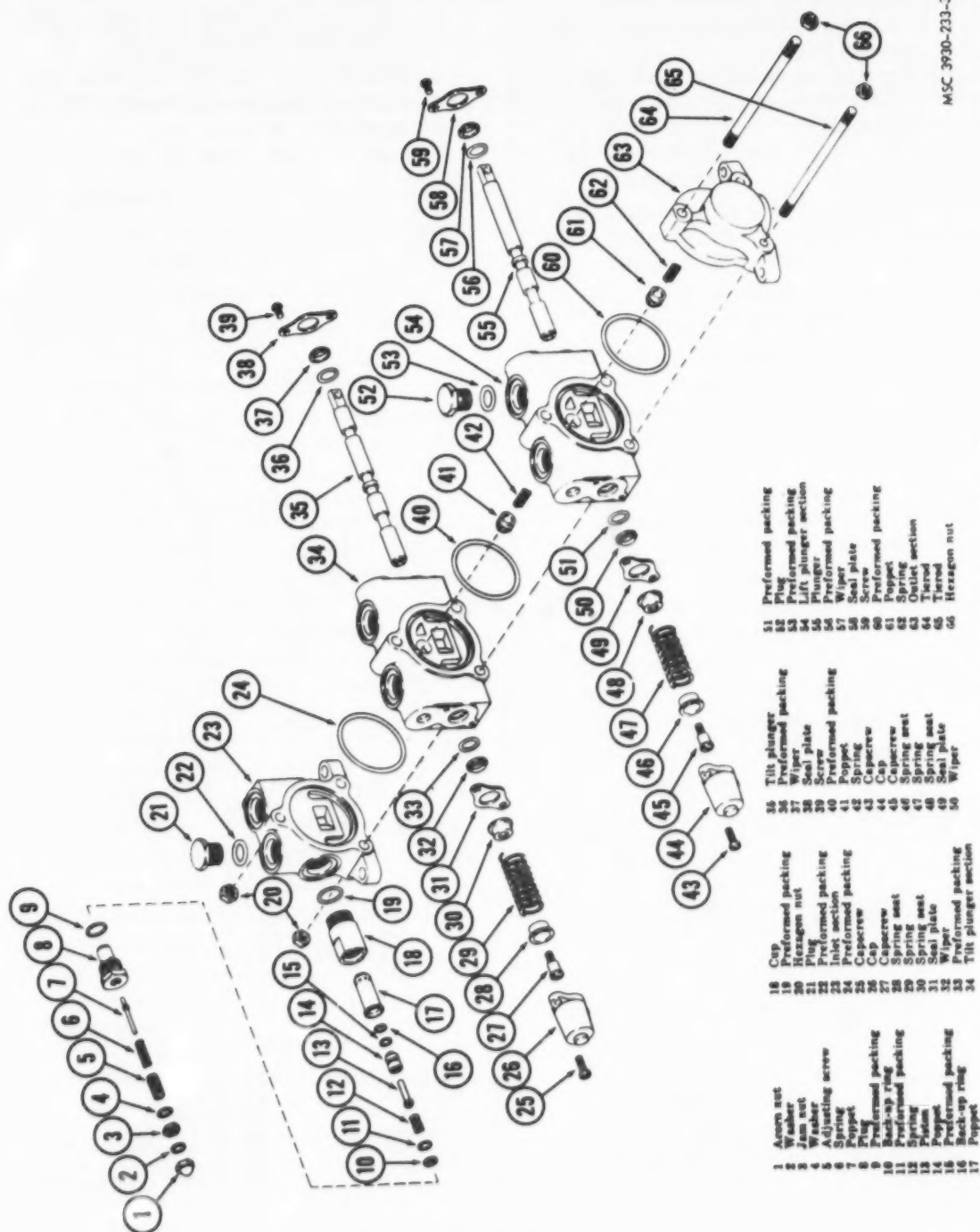


Figure 58. Hydraulic control valve.

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(11) Install shaft seal (11), being careful not to damage seal when installing over splined shaft (oil seal liberally before assembly).

(12) Rotate pump shaft by hand. Pump should have a small amount of drag, but should turn freely after a short period of use.

f. Installation. Installation is a direct reversal of *b* above.

48. Hydraulic Control Valve

a. Description. The hydraulic system control valve contains two plunger sections; an inlet section, two plunger sections, and an outlet section. Each of these sections may be replaced separately. All parts of the sections may be replaced individually except the plunger section housings and their selective fit plungers, which must be replaced as units.

b. Removal.

- (1) Remove side panel on right side of truck (TM 10-3930-233-20).
- (2) Remove cotter pins (10, fig. 55) and pins (7, 14).
- (3) Remove all hydraulic lines to control valve (par. 55).
- (4) Remove control valve assembly from truck.

c. Disassembly.

Caution: It is extremely important that all parts be kept clean at all times, and that all machined surfaces be protected from nicks, scoring, gouging, and other damage. Disassemble valve assembly only as far as is necessary.

(1) Disassembly of inlet section.

- (a) Using a wrench of appropriate size, remove relief valve assembly from top of inlet housing by unscrewing cup (18, fig. 56).
- (b) Remove preformed packing (19).
- (c) Holding cup (18), unscrew and remove plug (9) and preformed packing (9) from cup (18).
- (d) Remove ring (10), preformed packing (11), spring (12), piston (13),

poppet (14), preformed packing (15), ring (16), and poppet (17) from cup (18).

(e) Remove acorn nut (1), washer (2), jam nut (3), washer (4), screw (5), spring (6), and poppet (7) from plug (8).

(f) Remove plug (21) and preformed packing (22) from side of housing (as mounted on truck).

(2) Disassembly of first plunger section.

(a) Remove capscrews (25) and cap (26) from bottom of first plunger section (34).

(b) Remove capscrew (27), spring seats (28, 30), spring (29), seal plate (31), wiper ring (32), and preformed packing (33) from bottom of first plunger housing (34).

(c) Remove screws (39), seal plate (38), wiper ring (37), preformed packing (36), and plunger (35).

(3) Disassembly of second plunger section.

(a) Removal of second plunger section components is identical to (2) above for all parts associated with the plunger action.

(b) Remove plug (52) and preformed packing (53) from side of second plunger section (54).

(4) *Disassembly of outlet section.* There are no removeable parts to the outlet section (63).

(5) Disassembly of the housing sections.

(a) Remove nuts (66) and withdraw tie rods (64, 65).

(b) Separate inlet section (23) from first plunger section (34) and remove preformed packing (24).

(c) Separate first plunger section (34) from second plunger section (54), and remove preformed packing (40), poppet (41), and spring (42).

(d) Separate second plunger section (54) from outlet section (63) and remove preformed packing (60), poppet (61), and spring (62).

i. Cleaning and Inspection.

- (1) Clean all parts in approved solvents.
- (2) Inspect springs for cracks, wear, deformation, or signs of weakness.
- (3) Inspect all seals for cracks, cuts, or other damage.
- (4) Inspect all machined surfaces for nicks, scratches, gouges, or other damage which would cause internal or external leakage.
- (5) Inspect all housings for cracks, stripped threads, or other damage which could effect operation.
- (6) Inspect plungers and plunger bores for scoring, chips, nicks, cracks, or other damage which could result in internal or external leaks.
- (7) Replace seals and defective parts as authorized.

e. Assembly. Use Figure 51 as a guide to assembly.

Note. Recheck each part before assembly for dirt or damage.

- (1) Assemble in reverse order of Disassembly in *c* above.
- (2) Coat all seals with approved hydraulic oil before installing.
- (3) When assembling the four sections, stand them side-by-side, install the tie rods (64, 65) and nuts (20, 66), check preformed packing installations between sections, then tighten nuts to 18 foot pounds of torque.

f. Installation. Reverse Removal procedure in *b* above.

49. Levers and Linkage

a. Description. The two hydraulic system control levers, tilt and lift, are located in the operators compartment to the right of the instrument panel, and operates the hydraulic tilt and lift control valves located on the outer side of the same panel. Lever motion is transmitted by means of yokes and links.

b. Removal.

- (1) Remove right side panel (TM 10-3930-233-20).

- (2) Remove cotter pins (10, 11, 16, 17, fig. 55) pins (6, 7, 13, 14), and links (8, 15).
- (3) Remove capscrews (20, 22), lockwashers (19, 23), and slide levers (9, 18) off handles (2, 4). Remove woodruff key (5, 12).
- (4) Remove washers (21, 24) and handles (2, 4) from bushing in cowl panel.
- (5) Remove knobs (1, 3) from handles.

c. Cleaning and Inspection.

- (1) Clean all metal parts in SD, and dry.
- (2) Inspect all bearing surfaces in cowl bushing, links, levers, valve plunger ends, and on handles, and pins, for cracks, bends, corrosion or other damage which would tend to cause resistance to valve return spring action.
- (3) Replace defective parts as authorized.

d. Assembly and Installation. Assembly and installation is a direct reversal of Removal procedures in *b* above.

50. Hydraulic Reservoir

a. Description. The purpose of the hydraulic tank is to hold sufficient oil for the entire hydraulic system. It is here that most of the foreign material, such as dirt or water, can enter the oil. Its construction is such that it must be kept filled within two inches of the top when all cylinders are retracted, to insure adequate fluid to fully extend all the cylinders.

The suction line on one side of the tank is located near the bottom to prevent air from being drawn into the pump, causing pump noise and erratic operation of the system. The return line is always connected to the opposite side of the tank, also near the bottom. This is to help prevent foaming of the oil.

An air vent is installed on top of the tank and attached to it is an air filter. As the oil level changes, due to use in the hydraulic system, air is drawn in or pushed out of the tank. The air filter should be kept clean to help keep dirt out of the oil tank. Filling the tank is accomplished by removing the air filter.

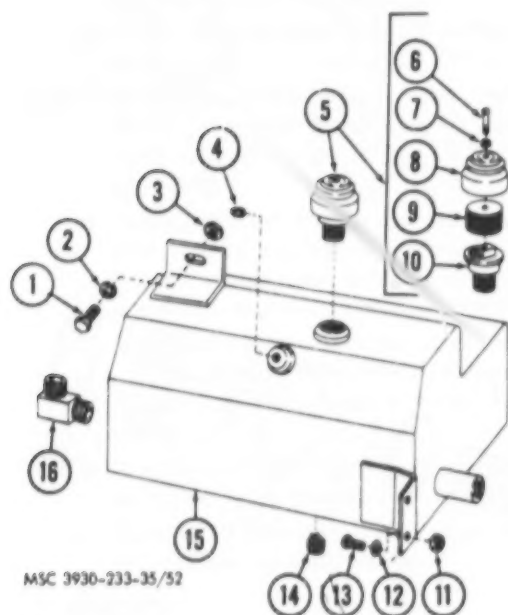
A magnetic drain plug is provided on the bottom of the tank to drain out all the oil when necessary.

Caution: Always refer to LO 10-3930-233-20. NEVER USE BRAKE FLUID. Make sure containers and surrounding parts are clean when filling tank, to prevent dirt from containers and surrounding parts are clean when filling tank, to prevent dirt from contaminating the oil. Any hydraulic oil used should contain a rust preventive, oxidation inhibitor, and should not foam.

The reservoir is located under the floor plate in the drivers compartment, just to the rear of the brake master cylinder, on the right side.

b. Removal.

- (1) Lift front end of truck, and block in position to allow hydraulic tank to be dropped and removed.
- (2) Remove drain plug (14, fig. 57) and drain hydraulic system.



- | | |
|--------------------|------------------|
| 1 Capscrew | 9 Filter element |
| 2 Lockwasher | 10 Filler body |
| 3 Nut | 11 Nut |
| 4 Pipe plug (1/4") | 12 Lockwasher |
| 5 Filler cap | 13 Capscrew |
| 6 Screw | 14 Drain plug |
| 7 Lockwasher | 15 Reservoir |
| 8 Cover | 16 Elbow |

- (3) Remove hydraulic lines connected to reservoir (15, 22, fig. 52).
- (4) Support tank, then remove capscrews (1, 3, fig. 57), lockwashers (2, 12), and nuts (3, 11).
- (5) Lower tank from truck.

c. *Cleaning, Inspection, and Repair.* Follow the same procedures as those given in Paragraph 24 for Cleaning and Repair of the fuel tank.

d. *Installation.* Reverse Removal procedures in b above.

51. Tilt Cylinders

a. *Description.* The two double acting tilt cylinders provide the means for tilting the mast assembly 3° forward and 10° back. They are located under the floor plate of the drivers compartment, and pivoted at frame and mast brackets. Action of the tilt cylinder is a straight line motion. Any misalignment between the cylinder and piston will cause binding, rapid wear of packing and packing gland, rapid wear of piston rod and packing, and tend to break the weld on the cylinder case. The welded section is designed to hold hydraulic pressure and should not be called upon to hold any bending action due to misalignment.

b. Service.

- (1) At every lubrication period the tilt cylinder mounting should be checked.
- (2) Make certain the yoke bolt is tight so that the plunger will not rotate in the cylinder.
- (3) Check stroke of both plungers to make sure they are the same. Uneven stroke can cause serious damage to the cylinders, frame and mast structure.
- (4) Check for any oil leakage at the packing gland and at hose connections. Oil seepage at the packing gland indicates packing is slightly worn or that gland nut may not be tight enough. If seepage is only slight, it may be stopped by merely tightening the gland nut with a spanner wrench.
- (5) If the leak does not stop after tightening the gland, or is excessive, inspect

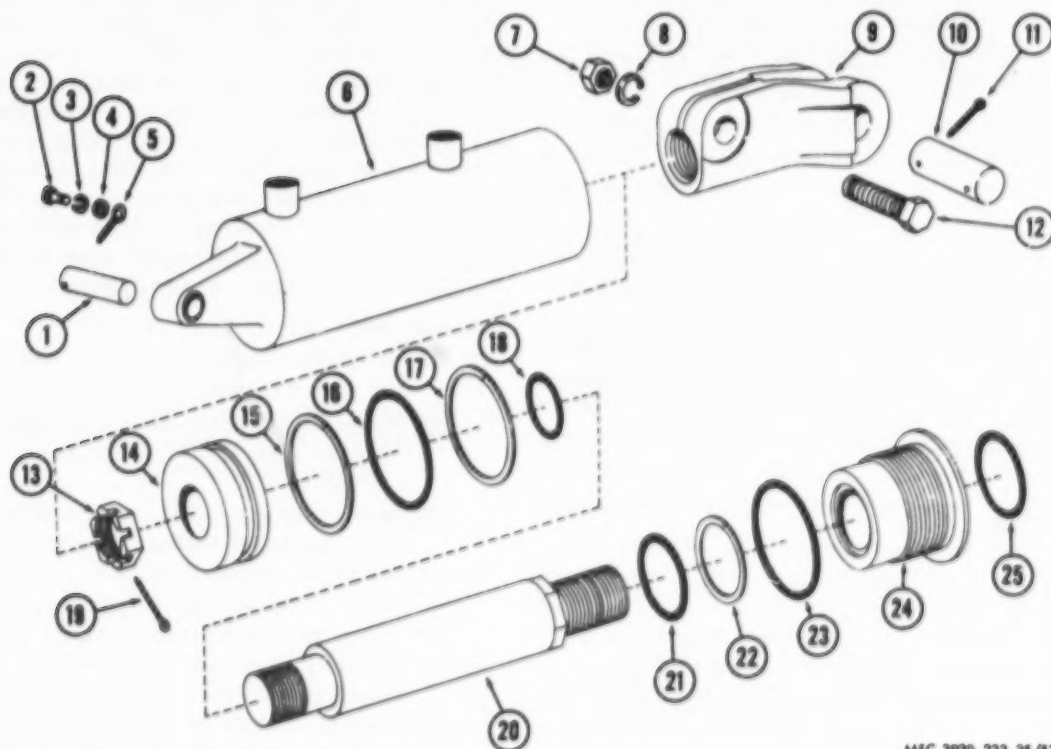
- (a) Tilt mast forward and inspect piston rod for scratches or scores.
 - (b) Remove scratches or scores, using a fine emery paper and polish with crocus cloth.
- Caution:** Do not polish lengthwise, but use rotary motion.
- (c) If piston rod will not clean up to a smooth finish, it is recommended that the rod be replaced.
 - (6) If mast tilts too slowly or creeps under load, oil is probably leaking past packing cups, and can be checked by:
 - (a) Tilt mast forward to extreme limit.
 - (b) Disconnect hose at front or mast end of cylinders.

- (c) Hold tilt control handle in forward position, accelerate engine to develop pressure and check for oil flow through open cylinder fitting.
- (d) If oil flows out of fitting of either cylinder, remove and replace packing.
- (e) If oil does not flow out of either fitting, the fault is in the control valve (par. 48).

c. Removal. See TM 10-3930-233-20.

d. Disassembly.

- (1) Secure tilt cylinder in bench vise. Be careful not to deform cylinder.
- (2) Remove capscrew (12), lockwasher



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- 1 Pivot shaft
- 2 Capscrew
- 3 Lockwasher
- 4 Washer
- 5 Cotter pin
- 6 Tilt cylinder tube
- 7 Nut

- 8 Lockwasher
- 9 Yoke
- 10 Yoke pin
- 11 Cotter pin
- 12 Capscrew
- 13 Slotted nut

- 14 Piston
- 15 Backup washer
- 16 Gasket
- 17 Backup washer
- 18 Preformed packing
- 19 Cotter pin

- 20 Plunger
- 21 Gasket
- 22 Backup washer
- 23 Preformed packing
- 24 Gland nut
- 25 Wiper ring

Figure 88. Hydraulic tilt cylinder.

(8), and yoke (9). The yoke is threaded onto the tilt cylinder plunger.

(3) Remove gland nut (24) and preformed packing (23).

(4) Remove wiper ring (25), gasket (21), and spiral backup washer (22) from inside gland nut.

(5) Withdraw plunger (20) from cylinder tube assembly (6).

(6) Remove cotter pin (19), castellated nut (13), and piston assembly (14) from plunger (20).

(7) Remove preformed packing (18) from bore of piston.

(8) Remove gasket (16) and the two backup washers (15, 17) from the groove around outside diameter of piston.

e. Cleaning and Inspection.

(1) Clean all metal parts with approved solvent and dry thoroughly.

(2) Check cylinder tube bore for scores or nicks.

(3) Check piston sliding surface for scores, nicks, or other irregularities which could damage cylinder tube bore, or quad ring.

(4) Check bores of piston and gland nut, and mating surfaces of plunger for damage which could cause faulty seating, leaks, or damage to other parts.

(5) Check all backup washers and other hardware for cracks, bends, deformation, stripped threads, and other damage.

(6) If mating or sliding surfaces are damaged, the parts should be replaced.

(7) Replace all packings, quad rings, and wiper rings as authorized.

f. Assembly.

(1) Assemble tilt cylinder in reverse order of procedures in Disassembly (d above), with the addition of the following:

(a) Dip all packings, gaskets and wiper rings in hydraulic oil before assembly.

(b) Oil piston, plunger and gland nut before installation.

(c) When installing gasket (16) on piston (14), do not stretch ring any more than absolutely necessary to install.

(d) Do not expand backup washers any more than necessary.

Caution: Never use sharp tools or instruments when installing rings, packings, or backup washers.

(e) Torque castellated nut (13) to 300 foot-pounds, and install cotter pin (19).

(f) Tighten gland nut securely, then back off approximately $\frac{1}{8}$ turn.

g. Installation. See TM 10-3930-233-20.

(2) Be certain that all parts are kept clean during installation and that no dirt or water is allowed to enter the cylinder before the hydraulic lines are connected.

52. Lift Cylinder

a. Description. The high free lift cylinder is a telescopic cylinder assembly. Variations in load weight and area of displacement within the multiple sections of the cylinder cause these sections to telescope in proper sequence. In operation the primary, that section which mounts the chain sprockets, will extend first to its full stroke, lifting the fork carriage only. Pressure is then automatically transferred to the secondary or center plunger causing it to telescope, thus lifting both fork carriage and inner mast. When lowering, the action is reversed. The secondary plunger will collapse first to the end of its stroke and then the primary plunger will follow. Proper sequence for lowering is aided by a flow regulator installed in the outlet fitting of the cylinder assembly.

b. Removal.

(1) Lower fork carriage, and remove carriage backrest (par. 54).

(2) Free cylinder end of lift chains (TM 10-3930-233-20).

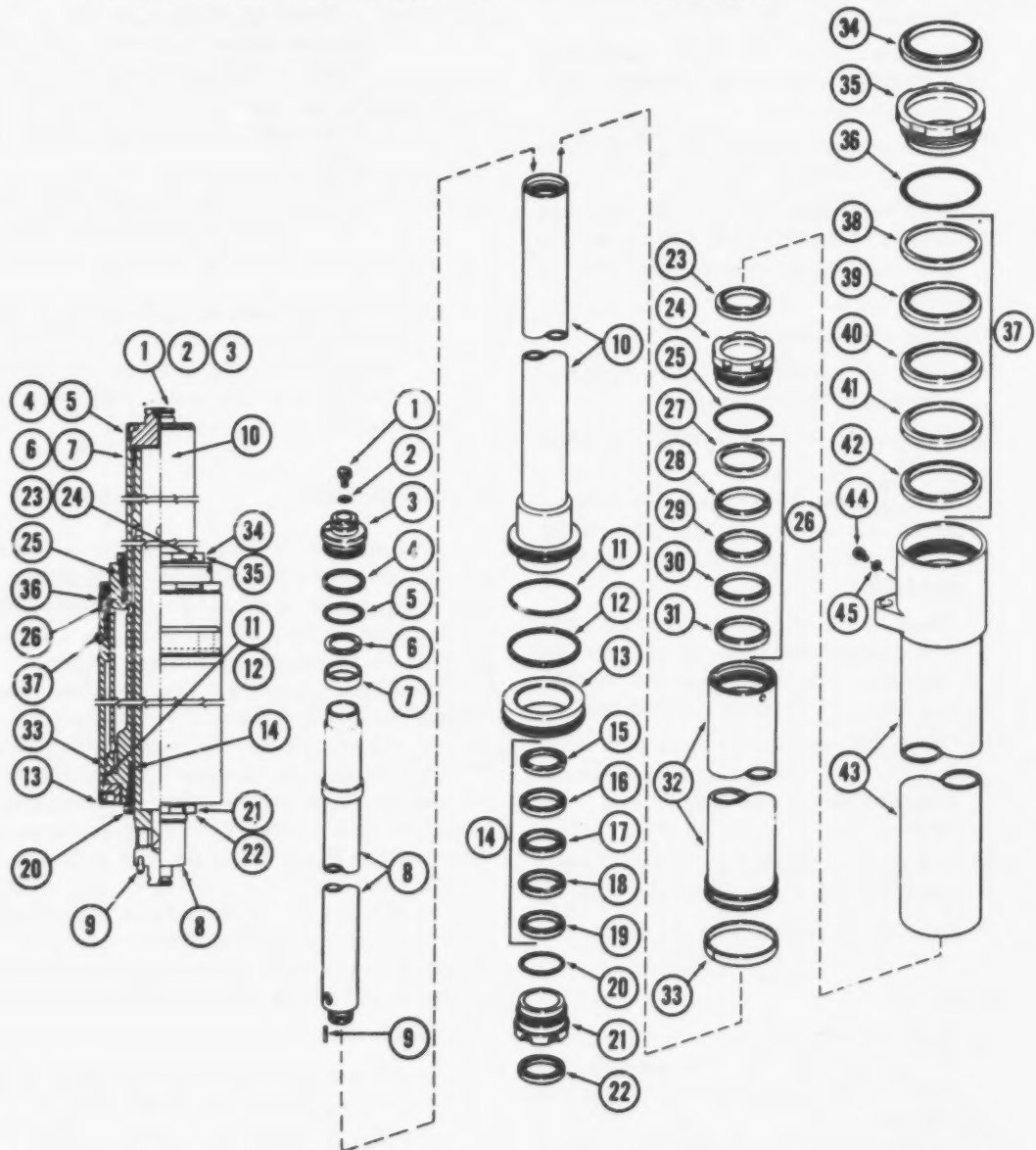
(3) Remove bleeder screw (1, fig. 59)

from cylinder case, and insert air hose. With lift control valve held in DOWN position, blow oil out of cylinder back into reservoir.

- (4) Disconnect hydraulic lines to lift cylinder.
- (5) Remove snap rings (8, 32, fig. 61) and split rings (2, 33) holding upper and

lower ends of cylinder assembly to mast.

- (6) Use chain hoist to lift inner mast (1, fig. 61) approximately six inches, and block in place.
- (7) Attach chain securely around outer case of cylinder assembly below chain bolt flanges.



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Figure 59. Hydraulic lift cylinder.

- (8) Attach hoist to chain, and lift cylinder assembly, gently, to clear both upper and lower ends of cylinder from mast assembly, and remove.

Caution: Be careful not to damage cylinder assembly when removing it from mast assembly.

c. Disassembly.

- (1) Place cylinder assembly in bench vise and drain any remaining oil.
- (2) Remove packing gland (21), fig. 59 its associated wiper ring (22) adapter (19), and packings (15, 16, 17, 18) and head assembly (3) from the secondary ram (10).
- (3) Very carefully extract inner-most ram (8) through the top of the secondary ram.
- (4) Remove packing gland (24) with its associated wiper ring (23), adapter (27), and packings (28, 29, 30, 31).
- (5) Remove lock ring (13), then gently extract secondary ram (10) through bottom end of primary ram (32).
- (6) Remove packing gland (35) with its associated wiper ring (34), adapter (38), and packings (39, 40, 41, 42), then very carefully extract primary ram (32) through lower end of outer cylinder casing (43).

d. Cleaning and Inspection.

- (1) Clean all metal parts with approved solvents.
- (2) Inspect rams (8, 10, 32), cylinder case (43), packing glands (21, 24, 35), lock

ring (13), and head (3) for cracks, nicks, scores, dents, bends, wear on sliding surfaces, stripped threads and other damage.

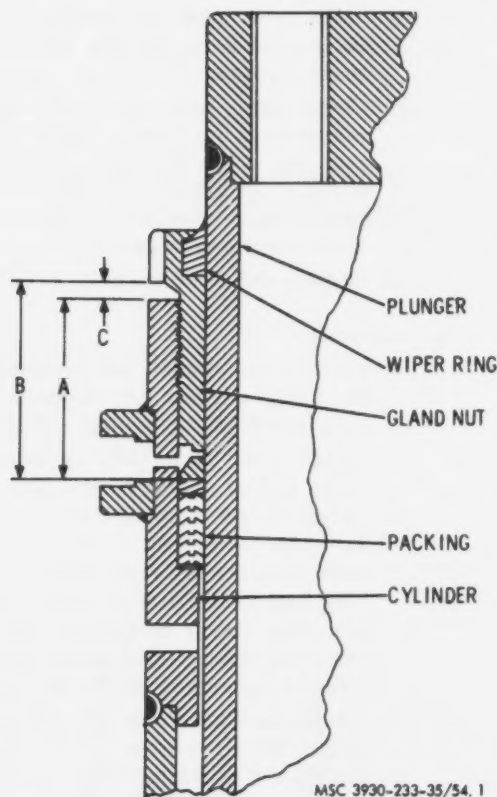
- (3) Check wear ring (33) and packing components for wear, cracks, scores, cuts and other damage. Check these not only for damage to themselves but as a possible clue to damage internal to the rams and cylinder.
- (4) Replace defective parts as authorized.

e. Assembly.

- (1) Place outer cylinder case in bench vise, be careful not to apply excessive pressure which might deform cylinder.
- (2) Install wear ring (33) in groove at lower end of primary ram (32).
- (3) Carefully insert upper end of primary ram into lower end of outer cylinder case. Gently slide ram, including wear ring end, into cylinder case. Use piston ring clamp or similar device to compress wear ring to enable insertion without damage to ring or cylinder.
- (4) Install packing rings (39, 40, 41, 42) with "W" lips away from packing gland, one at a time, dipping them in hydraulic oil and making sure edges of rings do not curl up. Seat them gently but firmly by tapping with a blunt tool.
- (5) Install top adapter ring (38). Make sure flat side is up and ring is firmly seated on packing.
- (6) To take measurements, it is necessary to first measure the distance (A) from the top of the packing assembly to the

1 Machine screw (bleeder)	16 Preformed W packing	31 Preformed W packing
2 Washer	17 Preformed W packing	32 Outer ram
3 End head	18 Preformed W packing	33 Wear ring
4 Washer	19 Adapter ring	34 Wiper seal
5 Preformed packing	20 Preformed packing	35 Outer gland nut
6 Snap ring	21 Lower gland nut	36 Preformed packing
7 Bushing	22 Wiper seal	37 Packing set (38 thru 42)
8 Inner ram	23 Wiper seal	38 Adapter ring
9 Groove pin	24 Upper gland nut	39 Preformed W packing
10 Intermediate ram	25 Preformed packing	40 Preformed W packing
11 Preformed packing	26 Packing set (27 thru 31)	41 Preformed W packing
12 Backup washer	27 Adapter ring	42 Preformed W packing
13 Lock ring	28 Preformed W packing	43 Outer cylinder
14 Packing set (15 thru 19)	29 Preformed W packing	44 Machine screw
15 Preformed W packing	30 Preformed W packing	45 Washer

Figure 59.—Continued



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Figure 60. Gland nut and packing adjustment.

top edge of the cylinder case. Then measure the length (B) of the packing nut from the bottom edge of the nut flange to the bottom surface of the nut. The difference between the two measurements will be (C). This is the amount of gap to be left when tightening the nut. In this position, packing nut will just barely touch the packing assembly. See figure 54.1.

(7) Install preformed packing (36) in grooved lower end of packing gland (35) and the wiper ring (34) in the upper end.

(8) Install nut to predetermined depth. Do not over tighten as this will distort rings and allow oil leakage. At the same time do not leave too loose as oil will blow by packing and damage edges. The nut must just touch the packing.

Caution: Because of the characteristics of "W" type packing rings, never tighten down hard. In fact, loosening slightly will often stop leaks. Overtightening can score cylinder.

(9) Install preformed packing (11) and backup washer (12) in grooved ridge at lower end of secondary ram (10), in order shown in Figure 59.

(10) Carefully install secondary ram (10) into lower end of primary ram (32). Use thin shim stock or piston ring compressor to ease preformed packing into primary ram.

(11) Install packing rings (28, 29, 30, 31), adapter ring (27), preformed packing (25), wiper ring (23), and packing gland (24) following same procedures as those in (4) through (8) above.

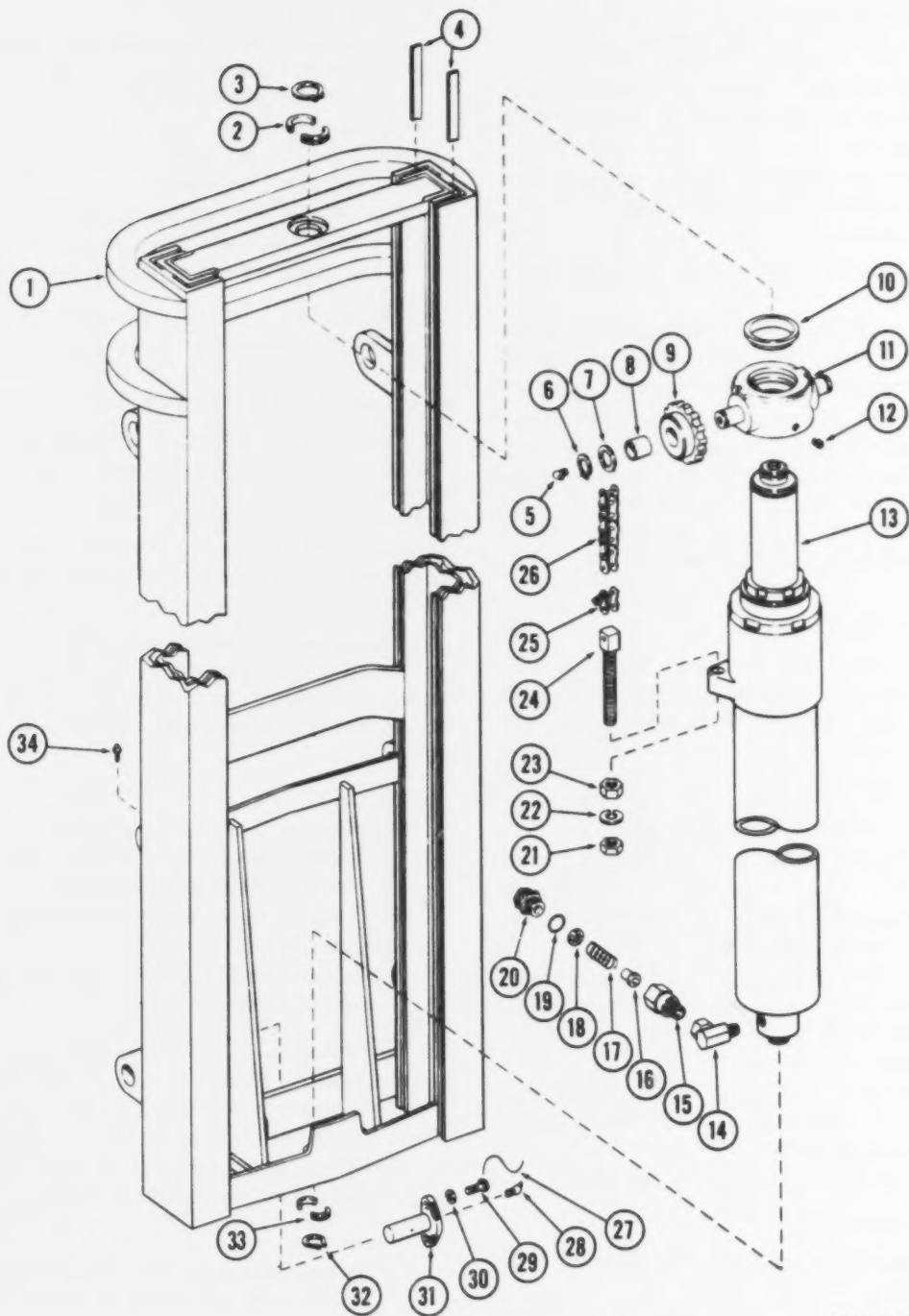
(12) Install guide bushing (7) and snap ring (6) on upper end of inner ram assembly (8).

(13) Carefully insert inner ram (8) into upper end of secondary ram (10).

(14) Install preformed packing (5), backup washer (4), and end head (3).

1 Mast assembly	10 Wiper ring	19 Preformed packing	27 Lockwire
2 Split ring	11 Cross head	20 Regulator body	28 Grease fitting
3 Retaining ring	12 Set screw	21 Nut	29 Capscrew
4 Wear strip	13 Lift cylinder assembly	22 Lockwasher	30 Lockwasher
5 Grease fitting, 90°	14 90° adapter	23 Nut	31 Mast pivot pin
6 Snap ring	15 Straight adapter	24 Chain anchor	32 Retaining ring
7 Flat washer	16 Spacer	25 Connecting link	33 Split ring
8 Bushing	17 Spring	26 Chain	34 Straight grease fitting
9 Sprocket	18 Regulator washer		

Figure 61. Hydraulic lift mast.



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Figure 61.—Continued

- (15) Install packings rings (15, 16, 17, 18), adapter ring (19), preformed packing (20), wiper ring (22), and packing gland (21), following same instructions as those in (4) through (8) above.
- (16) Install machine screws (1, 44) and preformed packings (2, 45).

f. Installation.

- (1) Reverse Removal instructions in *b* above.

Caution: Be certain that all parts are clean and that there is no foreign matter in the cylinder case and rams.

- (2) When cylinder has been installed, run lift to extreme upper limit then open bleeder screw (1) one or two turns. Allow trapped air and foamy oil to run out. When a clear stream of oil appears, tighten bleeder screw.

53. Hydraulic Lift Mast

a. Description. The hydraulic lift mast consists of inner and outer masts with wear plate in the sliding channels to provide maximum ease of movement.

b. Removal.

- (1) Remove lift forks (par. 44).
- (2) Remove hydraulic tilt cylinder (par. 52).
- (3) Remove tilt cylinder yokes from mast brackets (par. 51).
- (4) Attach chain hoist to lift ears on back of outer mast, and raise mast assembly enough to take weight off pivot pins (31, fig. 61).
- (5) Remove lockwires (27), capscrews (29), lockwashers (30), and remove pivot pins (31).
- (6) Lift mast assembly free of truck.

c. Disassembly.

- (1) Lay mast assembly on suitable support.
- (2) Slide inner mast out of outer mast.
- (3) Remove carriage assembly by sliding out of mast channel.
- (4) Remove wear strips as necessary.

d. Inspection.

- (1) Inspect mast channels for misalignment, broken welds, excessive wear, worn or damaged wear strips.
- (2) Inspect pivot and tilt cylinder yoke brackets for wear or damage. Check the pivot bushing.
- (3) Repair by welding if practical, and provided heat distortion is avoided.
- (4) Replace defective parts as authorized.

e. Installation. Install hydraulic lift mast by reversing procedures in Removal, *b* above.

54. Carriage and Backrest Assemblies

a. Description. The fork lift carriage is a welded assembly having horizontal upper and lower fork support bars and a pair of vertical carriage support bars (fig. 62). The vertical bars each carry upper and lower stud and bearing assemblies which ride in the channel of the inner mast.

The backrest is a welded metal frame, which is attached to the upper fork support bar of the carriage, and serves to prevent loads from resting against the mast when the mast is tilted back.

b. Removal.

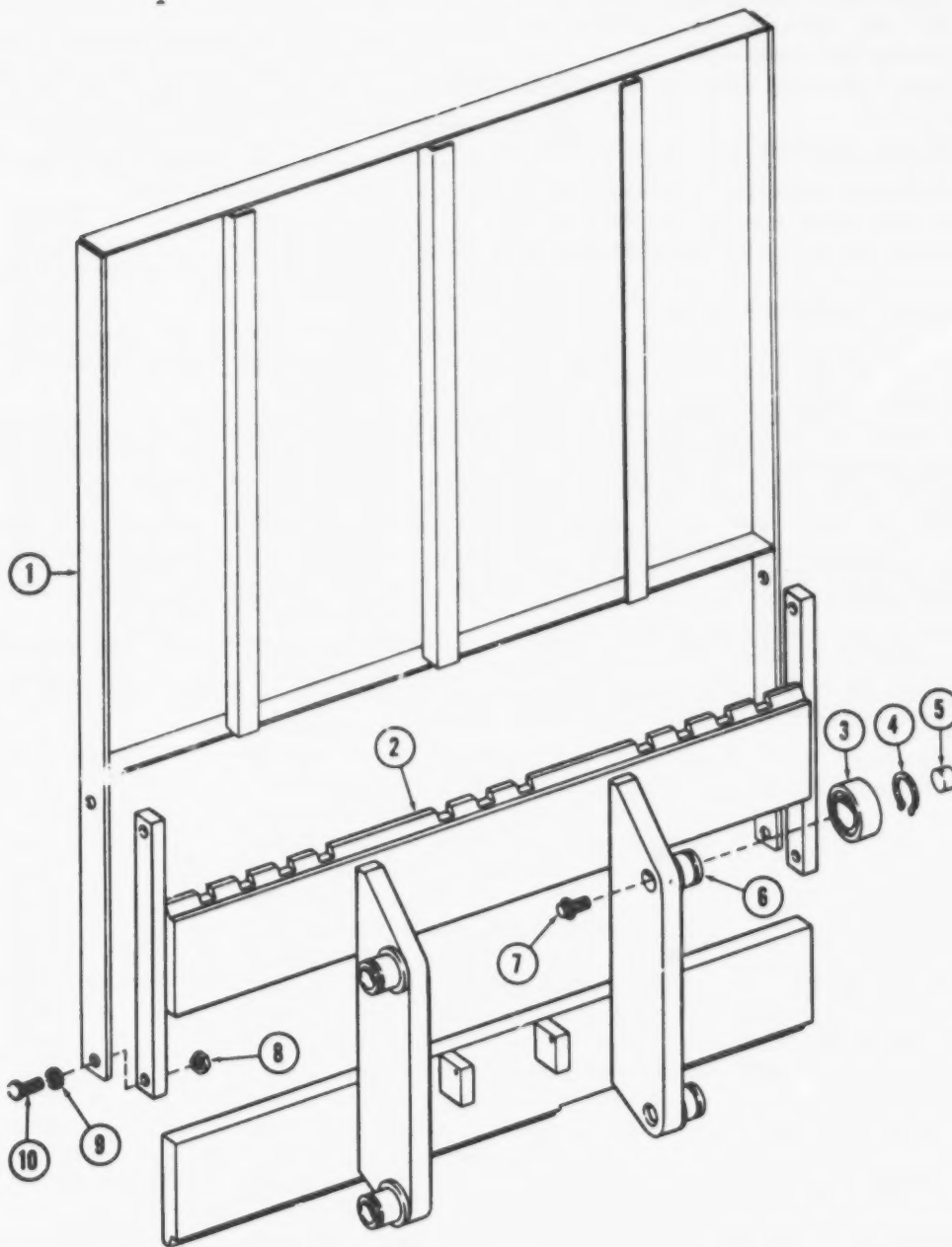
- (1) Support backrest with hoist, remove capscrews (10, fig. 62), nuts (8), then lift backrest free of carriage.
- (2) Remove inner mast from outer mast (par. 53).
- (3) Remove carriage from mast by sliding out of mast channel.

c. Disassembly.

- (1) Remove plugs (5) and screws (7).
- (2) Remove retaining rings (4) and bearings (3) from studs (6).
- (3) If necessary, studs (6) may be removed and replaced by welding.

d. Inspection.

- (1) Inspect backrest for cracked or broken welds, and any wear or bends which could interfere with heavy use.
- (2) Inspect carriage for cracked or broken welds, wear, bends, misalignment of the vertical bars, or other damage.



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- | | | | | |
|------------------|------------------|-----------------|------------------|--------------|
| 1 Backrest | 3 Roller bearing | 5 Plug | 7 12-point screw | 9 Lockwasher |
| 2 Carriage frame | 4 Retaining ring | 6 Stud assembly | 8 Hex nut | 10 Capcrew |

Figure 62. Hydraulic lift carriage and backrest.

- (3) Inspect stud, bearing and plug assembly for misalignment, cracks, or breaks, and excess wear.
- (4) Repair damaged parts by welding if practical.
- (5) Replace defective parts as authorized.

e. Assembly and Installation. Assembly and installation are the reverse of the procedures for disassembly and Removal in *b* and *c* above.

55. Hydraulic Lines and Fittings

a. Flexible hose is used to absorb vibration and shock, and for ease of maintenance. Metal tubing is used at points of maximum strain, such as at the hydraulic pump inlet and outlet, to minimize replacement. The flexible hose is constructed of an oil resistant, seamless, synthetic rubber compound inner tube, reinforced with cotton braid and high tensile strength wire braid. The inside diameter of the hose is determined by the volume of oil required, and pressure exerted by the various components of the hydraulic circuit. Unless apparent damage is incurred, hydraulic oil lines need practically no service. Check occasionally for leaks at fittings.

b. Removal.

- (1) Refer to the several hydraulic components paragraphs for removal of those components, and figure 47 for locations.
- (2) Remove any clamps which may hold lines to body or engine.

c. Inspection.

- (1) Inspect fittings for damage or stripped threads.
- (2) Inspect clamps for cracks, stripped threads or perforated bands, or other damage.
- (3) Inspect flexible lines for soft spots, cracks, breaks, punctures, fraying or other signs of damage and wear.
- (4) Inspect metal tubing for cracks, breaks, wear or corrosion leaks, bends which could greatly reduce effective oil flow, and other damage.
- (5) Replace defective parts as authorized.

d. Installation. Reverse procedures in *b* above.

APPENDIX REFERENCES

AR 310-1	General Policies
AR 320-5	Dictionary of United States Army Terms
AR 320-50	Authorized Abbreviations and Brevity Codes
AR 600-55	Motor Vehicle Driver Selection, Testing, and Licensing
AR 700-58	Report of Damaged or Improper Shipment
AR 700-3900-5	Registration of Materials Handling Equipment and Special Purpose Vehicles
AR 743-505	Limited Storage of Engineers Mechanical Equipment
AR 746-2300-1	Color and Marking of Vehicles and Equipment
AR 750-5	Organization, Policies and Responsibilities for Maintenance Operations
AR 750-3900-1	Materials Handling Equipment
AR 754-9130-1	Utilization of Automotive Gasoline
C-9100SL	Petroleum; Petroleum-Base Products and Related Material
DA Pam 108-1	Index of Army Motion Pictures, Film Strips, Slides, and Phonorecordings
DA Pam 310-1	Military Publications: Index of Administrative Publications
DA Pam 310-2	Military Publications: Index of Blank Forms
DA Pam 310-3	Military Publications: Index of Doctrinal Training and Organizational Publications
DA Pam 310-4	Military Publications: Index of Technical Manuals, Technical Bulletins, Supply, Bulletins, Lubrication Orders, and Modification Work Orders
DA Pam 310-5	Index of Graphic Training Aids and Devices
DA Pam 310-25	Index of Supply Manuals—Corps of Engineers
FM 5-25	Explosive and Demolition
FM 21-5	Military Training
FM 21-6	Techniques of Military Instruction
FM 21-30	Military Symbols
TB ENG 60	Preservation and Painting of Serviceable Corps of Engineers Equipment
TB ENG 347	Winterization Techniques for Engineer Equipment
TM 6-687	Repair and Utilities: Fire Protection Equipment and Appliances: Inspection, Operations, and Preventive Maintenance
TM 5-764	Electric Motor and Generator Repair
TM 9-200	General Packaging Instructions for Ordnance General Supplies
TM 9-1799	Ordnance Maintenance, Fire Extinguisher
TM 9-6140-200-15	Operation and Organizational, Field and Depot Maintenance: Storage Batteries, Lead-Acid Type
TM 10-3930-233-10	Operator's Manual; Truck, Lift, Fork, Gasoline, Solid Rubber Tired Wheels, 2,000 lbs Capacity (Allis-Chalmers Models FT20-24PS-100) (FSN 3930-958-3682 and FT20-24PS-127) (FSN 3930-958-3683), Army Model MHE-182
TM 10-3930-233-20	Organizational Maintenance Manual; Truck, Lift, Fork, Gasoline, Solid Rubber Tired Wheels, 2,000 lbs Capacity (Allis-Chalmers Models FT20-24PS-100) (FSN 3930-958-3682) and FT20-24PS-127 (FSN 3930-958-3683), Army Model MHE-182.

TM 10-3930-233-20P	Organizational Maintenance Repair Parts and Special Tool Lists; Truck, Lift, Fork, Gasoline, Solid Rubber Tired Wheels, 2,000 lbs Capacity, (Allis-Chalmers Models FT20-24PS-100) (FSN 3930-958-3682) and FT20-24PS-127 (FSN 3930-958-3683), Army Model MHE-182.
TM 10-3930-2 3-35P	Field and Depot Maintenance Repair Parts and Special Tools Lists; Truck Lift, Fork, Gasoline, Solid Rubber Tired Wheels, 2000 lb Capacity, (Allis-Chalmers Models FT20-24PS-100) (FSN 3930-958-3682) and (FT20-24PS-127) (FSN 3930-958-3683) Army Model MHE-182
TM 11-483	Radio Interference Suppression
TM 21-300	Driver Selection and Training (Wheeled Vehicles)
TM 38-230	Preservation, Packaging, and Packing of Military Supplies and Equipment
TM 38-750	The Army Equipment Record System and Procedures
MIL-STD-162A	Preparation for Delivery of Warehouse Materials Handling Equipment for Domestic and Oversea Shipment and Storage
LO 10-3930-233-20	Lubrication Order; Truck, Lift, Forks, Gasoline, Solid Rubber Tired Wheels, 2,000 lbs Capacity (Allis-Chalmers Models FT20-24PS-100) (FSN 3930-958-3682) and (FT20-24PS-127) (FSN 3930-958-3683), Army Model MHE-182

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For explanation of abbreviations used, see AR 320-60.

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